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THE SIZE OF OCEAN WAVES.—III.

By VAUGHAN CORNISH, M.SC.(VICT.), F.C.S., F.R.G.S.,
Associate of the Owens College.

IN a previous article I gave the results of Admiral Coupvent des Bois' attempt to connect the average height of the waves with the strength of the wind. The Table VI. embodying this result was the outcome of about 7000 observations made on board the *Astrolabe*. More recently Captain D. Wilson-Barker, H.M.S. *Worcester*, has published* a table showing the connection between wind and wave according to his own experience. This extends over many years at sea, during which he was nine times round the world in sailing ships in high southern latitudes, and made many measurements of waves combined with simultaneous observations on the strength of the wind.

TABLE VII.

Wind velocity and corresponding sea disturbance (D. Wilson-Barker).

Beaufort Scale.	Description of Wind.	Velocity in Miles per Hour.	Sea Disturbance.	Height of Waves in Feet.	Description of Sea.
0	Calm	0	0	0	Calm
1	Light airs ...	3	1	0–1	Very smooth
2	Light breeze ...	9	2	1–2	Smooth
3	Moderate breeze	16	3	2–3	Slight
4	Fresh breeze ...	24	4	3–5	Moderate
5	Strong breeze ...	34	5	6–10	Rather rough
6	Gale	42	6	10–18	Rough
7	Strong gale ...	55	7	18–28	High
8	Hurricane ...	70	8	28	Tremendous

The tables of Paris, Coupvent des Bois, and Wilson-Barker are not perfectly comparable throughout, but I think we may venture to arrange in parallel columns the four greatest values for average height of waves, and to assume provisionally that they represent three independent sets of observations of average height of waves in deep water and open sea, during strong breeze, gale, strong gale, and a gale of hurricane force.

TABLE VIII.

Height of Waves in feet.

	C. des Bois.	Paris.	Wilson-Barker.'
Hurricane	28·54	25·43	28
Strong gale	20·67	16·57	23
Gale	15·42	—	14
Strong breeze	10·83	—	8

With regard to the *length* of waves, I think most observers will agree that the greatest average length of wave is not observed where the wind is blowing strongly but where the sea is heaving with a steady swell in a comparatively calm atmosphere. Thus in Lieut. Paris' record the maximum average wave length for a single day (771 feet) occurs when the state of the sea is described as *grosse houle*, a heavy swell, whereas the greatest average length for a day of storm (très-grosse mer) was 590½ feet. As the average force of the wind for "très-grosse mer" was indicated by the number 9, and that for "grosse houle" by the number 5 (on a scale of 0-11), the above appears to be the necessary interpretation of Paris' figures. In this matter, however, we are fortunately able to adduce other evidence besides the observations made from ships at sea. Observations of the intervals of time between the breaking of the waves on shore are easily made, the intervals of time are greater for the larger waves, and the longer intervals are those recorded during "ground-swells" in calm or comparatively calm weather. Thus on December 29th, 1898, in the fine weather with north-westerly breeze following a great storm accompanying an atmospheric depression which had travelled quite across the Atlantic, I observed at Branksome Chine, near Bournemouth, an uninterrupted series of 139

* *Quarterly Journal of the Royal Meteorological Society*, Vol. XXV., No. 109, January, 1899, p. 15.

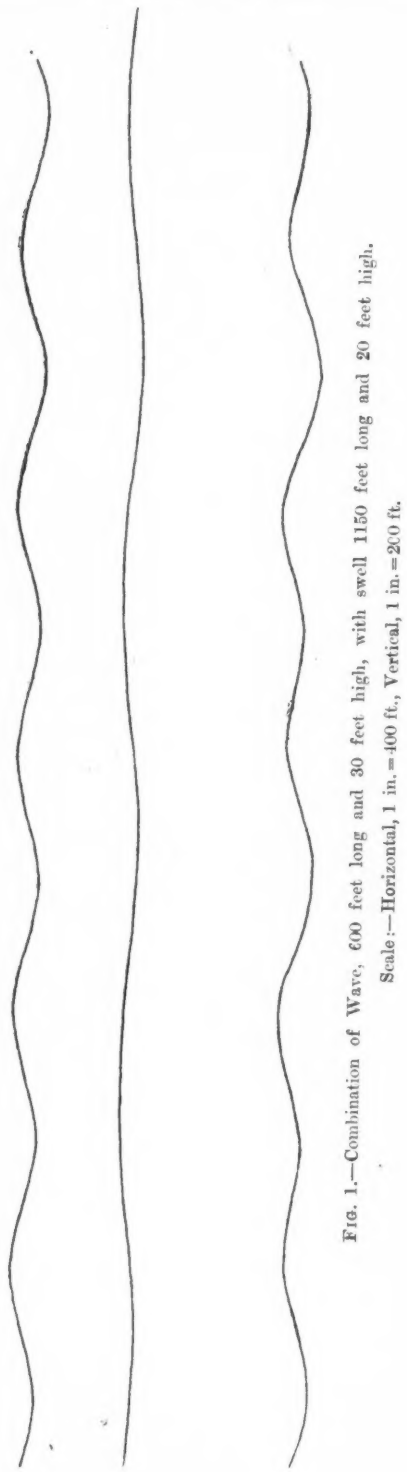

Fig. 1.—Combination of Wave, 600 feet long and 30 feet high, with swell 1150 feet long and 20 feet high.
Scale:—Horizontal, 1 in. = 400 ft., Vertical, 1 in. = 200 ft.

breakers. The average interval between succeeding breakers was 19.35 seconds, from which it follows that the average wave length in deep water must have been 1918 feet. This is calculated from the formula—

Length of wave in deep water in feet = square of the period in seconds × 5·123.

This formula is derived theoretically from the known behaviour of liquids under the action of gravity, and has been verified to some extent by observation. Its substantial accuracy when applied to a swell of no great steepness travelling in a fairly calm atmosphere is, I believe, beyond question. The corresponding velocity of the wave is 68.7 statute miles per hour in deep water, which is slightly less than the velocity assigned by Capt. Wilson-Barker to a storm of hurricane force. Sir George Gabriel Stokes has observed breakers with a uniform period of 17 seconds; and I find that a period of 15 seconds is not uncommon with westerly swells on the south coast of England. A 15 second period corresponds to a wave length in deep water of 1153 feet. Thus the average interval between the wave crests observed during a storm at sea seldom exceeds 600 feet, although the period of breakers frequently indicates a wave length twice as great.

I do not know whether attention has been drawn to this anomaly, and I have not met with any published facts which explain it. I propose the following explanation:—The swell frequently arrives before the storm; subsequently when the wind gets up the sea becomes covered with short steep waves; these grow in length, and gradually the swell becomes less conspicuous, until at last it is nearly or quite invisible in presence of the storm waves (say between 300 and 600 feet in wave length). The natural inference would be that the amplitude of the swell must be small as compared with that of the storm wave. This, however, is not necessarily the case, as an examination of the diagram will show. In looking at this it must be remembered that when waves are observed at sea we have not a fixed platform to observe from, nor can their profile be traced against any fixed structure. The ship rises and falls with the long swell, and the observer has very little notion where the line of mean sea level is; and for this reason I have not drawn any datum line in the diagram. What he does notice is whether the water surface at any place is convex or concave, and, more particularly he notices the advance of the convexities of crests.† Now it is obvious that even though the long swell have an amplitude equal to that of the shorter storm wave yet its curvature is less, and therefore it is less potent than the latter in determining the positions of crests, *i.e.*, marked convexities of surface.

To assume that during storms there is a long swell (say not less than 1100 feet) of an amplitude equal to that of the storm wave would, however, be going somewhat beyond what the facts seem to warrant, but that such invisible swells may have a considerable amplitude seems to me quite possible from what we know of the swell remaining after a storm, of the distances which these swells traverse, and of the size of the breakers which they yield, and finally of the variation of the amplitude of successive waves in a storm. Fig. 1 shows a portion of the actual wave surface due to the simultaneous existence of two undulations with length 600 feet, amplitude 30 feet, and length 1150 feet, amplitude 20 feet. Commencing on the left with the two undulations at the same phase, at mean sea level, and subsiding, there are shown in the figure five

† The curvature at the crest being sharper than in the troughs, a difference which, however, I have not shown in the diagram.

crests of the 600 feet undulation and three crests of the 1150 feet undulation. The resulting wave surface of the sea in this case would at any one moment show a series of ridges and hollows differing from one another in wave length and amplitude. This series would be followed by other series, identical with it. The third (lowest) line of the diagram is a portion of a series. It contains five wave crests, *i.e.*, the same number as the shorter constituent wave contains. Measuring from the diagram I find that, reckoning from the left, the succeeding waves have—

Amplitude 28·85 feet. Length 575 feet. Length 625 feet.
Amplitude 27·5 feet. Amplitude 30 feet.
Length 575 feet. Length 625 feet.
Amplitude 27·5 feet. Amplitude 35 feet.

The average wave length is 600 feet, precisely that of the shorter constituent, the average amplitude is 29.77 feet, which is (within the errors of measurement) identical with the amplitude of the same wave. The record of measurement of waves in such a sea as usually published, that is to say, giving the average dimensions of a series of waves, would give no indication of the existence of the long swell. It would perhaps be just visible if the light were good as something running faster than the waves, not unlike the shadow of a passing cloud upon the water, but I think its magnitude would be much under-estimated. This swell does not greatly affect the amount of surface disturbance, though it renders it more irregular; but at a depth where the effect of the 600 foot wave is no longer felt the heave of the 1150 foot swell is still strong. Thus, although the existence of the long swell may be barely discernible by the eye in a storm, and although the recorded (average) wave measurement may not reveal its presence, yet the sea is really in a very different state when such a swell is running from what it would be if affected only by the recorded wave of 600 foot length and 30 foot amplitude. In drawing figures in which the amplitude of the swell is made equal to that of the storm wave I do not intend to assert that this is the usual condition; the intention is rather to show how even a great swell is masked by the shorter wave.

I am trying in these articles to tell what is known about the size of ocean waves, and how that knowledge has been obtained. I have now reached the point, to which one comes sooner or later in almost every enquiry, when it is advisable to look more closely into the meaning of the word which designates the thing investigated. For research in natural phenomena I prefer this plan to that of beginning with a definition. We find the surface of the sea covered with a series of ridges and furrows which are not uniform on the one hand, but have on the other hand only a moderate range of size. There are of course wavelets also present, but these are easily distinguished from the greater waves which we want to measure. The difference in size between succeeding ridges seems to be mainly due to the existence of two or more sets of undulations each of which may be regular. An illustration of this may be obtained by watching one wave crest as it advances. The changes of form which it undergoes are readily understood on the supposition that one billow is catching up and passing another. These changes are the same as those shown in the figures in passing from crest to crest of the combined wave. Now if we want to know the size of ocean waves it is evident that we must make up our minds whether we mean the size of the ridges and furrows which at the time actually constitute the surface of the ocean, or, on the other hand, the size of the constituent undulations the superposition of which constitutes those ridges and furrows.

The actual ridge or mound of water is not only the chief visible phenomenon but it is also a tangible, often a terrible reality, which the sailor calls "a sea." On the other hand the constituent undulations are what chiefly receive the attention of the theoretical man, and they have in some respects a greater individuality than the "seas," for they retain each their length and speed, and, sorting themselves as they travel beyond the storm area, they partition out the ocean among them, the longest and swiftest coming to the front, the slower and shorter lagging behind.

In the systematic records of the size of ocean waves, writers have generally attempted to follow the procedure of the theoretical man in this matter. Thus Monsieur Bertin, in his excellent *Memoir on the Experimental Study of Waves*,‡ says, "We are certain in adopting 16 mètres (52½ feet) as the maximum limit of height to have got beyond all the observed values. I must further remark that I only speak of waves in the open sea, and of those belonging to a single swell. An isolated rock 25 or 30 mètres (82 to 98 feet) high may be covered by a breaking sea. Waves belonging to different systems of swell may ride one over the other, giving rise to topping seas without speed, and with a short period, or to any other irregular and exceptional agitation. . . . ."

In December, 1900, I crossed from Liverpool to Boston in ss. *Ivernia*, and heavy weather was met with. Quoting from the report sent in to the U. S. Hydrographic Office, we had on December 6th strong westerly winds with high sea; December 7th, strong squally wind, increasing to strong gale, with heavy regular sea; December 8th, strong gale, S.W., W., N.W.; December 9th, N.W. wind, moderate to force 6, and backing W.S.W., increasing to force 8; December 10th, fresh gale, with frequent squalls, wind hauling to N.N.E. and N.E., short high sea; December 11th, wind west, having hauled S. to S.S.W., increasing with hard snow squalls and falling thermometer, short high sea; December 12th, moderate gale to moderate breeze at midnight; December 13th, wind force 6-7, with occasional snow squalls, sea rough.

I paid particular attention to the question of the height of the waves, and tried to consider the matter without bias. It seemed to me quite as important to know the height of the larger seas occurring from time to time as the average height of the waves. Thus the average height of the waves on December 8th was less than the elevation of the lower deck, but the lower deck on the weather side was unsafe on account of the occasional big "seas," of which I measured one or two of 40 feet or upwards. It is these larger seas which rivet the attention, and remain in the recollection of a spectator. I do not think anyone could fairly be blamed for saying that on this occasion the ship met with waves about 40 feet high, for they were not seen only once but many times, yet, as well as I could guess, the *average* height of the waves was not more than 20-25 feet. I think it probable that when we hear from seamen that they have known the waves in a storm 40 feet, or it may be 50 or 60 feet, in height, we must interpret

‡ Institution of Naval Architects, April, 1873.

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the statement to mean that this is the measure, or estimate, of the average height of the greater waves of which some were encountered and a number seen during the storm, and I see no reason to quarrel with such a mode of statement. It admits, however, of an apparent discrepancy of probably 100 per cent. between the values assigned to the height of ocean waves according to whether we adopt the concrete or the abstract notion of a wave.

GIANT OSTRACODA: OLD AND NEW.

By the Rev. THOMAS R. R. STEBBING, M.A., F.R.S., F.L.S., etc.

As students are aware the species of Entomostraca are for the most part very inconspicuously conspicuous, and among those of them which are thus notable not for being very large but for being very little the Ostracoda, if not absolutely foremost, are certainly well to the front. Recent researches, however, have shown that in this group as in others an astonishing disparity of size may separate exceptional members of it not only from the minutest forms but from the average dimensions.

In 1880, Dr. G. S. Brady in the first volume of the "Challenger" Zoological Reports described a new genus and species from the South Pacific under the name *Crossophorus imperator*. After giving the length as "$\frac{1}{3}$ of an inch (8.4 mm.)," he refers to it with a kind of enthusiasm as "this noble species, certainly the largest of the known Cypridinidæ." The family in question was already itself distinguished among the Ostracoda by having representatives which could boast of some such exorbitant length as the sixth of an inch. By abruptly doubling this the *Crossophorus* would probably attain a bulk about eight times that of its largest known competitor. In 1896 Drs. Brady and Norman described another specimen, assigned to the same species, with a length of 7 mm. Though both specimens were reported from very great depths of nearly equal temperature, it is remarkable that the first, a male, was taken a little to the east of New Zealand, the second, a female, "was procured by the 'Porcupine' Expedition of 1869, in the Atlantic, west of Donegal Bay, Ireland." The same length of 7 mm. is reached by *Cyclasterope hendersoni*, Brady, 1897, which Mr. Henderson, of the Christian College, Madras, brought to light by dredging in Madras Harbour.

At the close of last year a new species, *Asterope arthuri*, 8 mm. long, was described among the crustacea brought by Dr. Arthur Willey from the South Seas. In regard to this interesting form it may be mentioned that before the specific name had been given, some of its appendages were figured in the volume of KNOWLEDGE for 1899, in the course of an essay dealing with the general structure of the Ostracoda (Vol. XXII., p. 31).

In 1898 Professor Sars described a new genus and species under the title "*Megalocypris princeps*, a gigantic fresh-water Ostracod from South Africa." This species, from a pond near Cape Town, attains a length of 7.30 mm., while apparently not full grown, and, as it belongs to the family Cyprididæ, in which the forms are usually very small, its "truly gigantic size" is even more surprising than that noted in the preceding instances. In 1900 M. Jules Richard reports a "*Gigantocypris*," about 10 mm. in diameter, as having been dredged by the Prince of Monaco from a great depth off the Azores.

These examples, however, do not exhaust the possibilities of the Ostracode group, for Dr. Gilchrist in December, 1899, while conducting marine investigations on board the South African Government vessel the "Peter Faure," and dredging in 90-100 fathoms off Cape St. Blaize, obtained specimens of Ostracoda which much surpass the dimensions above quoted. The specimens were speedily forwarded to me by Dr. Gilchrist, and were examined at once. That they have not been sooner recorded is due in part to the well-founded and growing dislike of preliminary notices, and in part to my apprehension that there had been made elsewhere an earlier discovery of a magnificent Ostracode, which might prove to be the same species. After talking the matter over with a scientific friend, I am now induced to think with him that the case is one of exceptional interest, in regard to which publication should no longer be delayed. The fact is that the specimens have a length of 15.5 mm. by a height of 12.5 mm., so that the noble *Crossophorus imperator* and the truly gigantic *Megalocypris princeps* are positively dwarfed by the comparison.

The new species, for which I propose the name *Crossophorus africanus*, has its generic position pretty well assured, since, among other points, to quote Brady and Norman, "the peculiar arrangement of the armature of the caudal laminæ is unlike that of any other known genus." But the new species, though agreeing in the general plan of arrangement, differs in detail, having only five principal spines instead of the seven which the smaller species displays. The mandibles have the bifid masticatory appendage, found in one or two other genera, but not there densely setulose as it is here. The maxillipeds have the large sub-triangular lamina, fringed with plumose setæ, and ending with a small lobe also fringed. This lobe is peculiar to *Crossophorus*, but it is much less clearly developed in the Irish specimen of *C. imperator* than in the New Zealand specimen. From the Irish *C. imperator* the new African species is strikingly distinguished by the apical part of the vermiform limb.* Here it forms a regular mouth, one jaw ending in a tooth, which confronts in the other a neat circlet of denticles. In the Irish specimen the tooth confronts "several (six?) finger-like curved processes which are ciliated on the edges." In the New Zealand specimen the limb is described as being "almost exactly like that of *Cypridina*." The result of these comparisons is to make me believe that we have to do with three specimens of the genus, first, the original *Crossophorus imperator*, Brady, from the Pacific; secondly, the species described by Brady and Norman, of nearly the same size, from the North Atlantic, which may be distinguished as *Crossophorus imperialis*; and thirdly, the new African species, *Crossophorus africanus*. For the latter detailed drawings have been already prepared, and these with accompanying description will, I hope, in due time more fully explain, and adequately justify this preliminary decision.

That an isopod which I find parasitic within the new species is itself likewise new may be affirmed without hesitation. The name I propose for this is *Cyproniscus crossophori*. It bears a strong resemblance to the much smaller *Cyproniscus cypridinæ*, Sars. Its distinctness will be apparent in the account and figures which are reserved for their appropriate place in the "Marine Investigations of South Africa," published by the Cape Government.

* For the general appearance of this strange appendage, see the figures in KNOWLEDGE, Vol. XXII., pp. 30, 31.

THE STRONGHOLD OF THE NUTHATCH.

A STORY OF SIEGE AND DEFENCE.

By A. H. MACHELL COX, M.A.

PICTURE a sleepy old rectory garden—a very paradise of birds—merging into a little rambling spinney, and lying so close beneath its shelter that the gradual, almost imperceptible transition only serves to enhance the sweet smell of the woodland. Here and there a fine old oak breaks the stiffness of surrounding evergreens. One such tree is so persistently visited all the year round by a pair of nuthatches as to arouse in the practised birds-nester a suspicion which a closer scrutiny proves to be well founded. At a height of rather more than thirty feet from the ground is a hole, clearly enough the socket of a branch long since defunct, and only arresting attention by its unnaturally smooth and rounded appearance. For such an eligible building site as this there must have been at one time applicants in plenty among the various birds that seek a habitation in ready-made cavities, but in the end our nuthatches evidently obtained the premises on a long lease, and for many a year (with one notable exception, to which I shall presently refer) their tenancy has remained undisputed. Nor is the reason far to seek. Against birds no larger than itself, the sturdily built nuthatch, with its strong formidable bill, is perfectly capable of holding its own, while against more determined aggressors like starlings it adopts the ingenious precaution of plastering up the entrance to its home with mud, and reducing it to such a size as will exactly meet its own requirements. This is a well-known peculiarity; that it forms an invariable feature of the household arrangement cannot indeed be positively asserted, but from all accounts the exceptions to the rule must be very few indeed. Similarly it is recorded that before a nuthatch can be induced to take possession of a nesting box in a garden, its habitual cuteness leads it to detect the lid opening on a hinge, so fatal to privacy, a drawback which it will at once proceed to remedy by a plentiful application of clay. So skilfully is the work done in the first instance, that when the nesting season comes round again, only slight repairs and alterations are required; but these receive the most scrupulous attention, and even in the depth of winter an occasional inspection is made, and these all important defences overhauled. I do not recollect ever having seen the male nuthatch assist his mate in any of the actual work, but he is invariably somewhere at hand in close attendance, and ever ready in the spring to serenade her with his cheery long-drawn whistle; in the winter he is perhaps apt to be self-assertive, but during the time of courtship I have watched him offering, with an air of the greatest gallantry, choice morsels of food to his mistress.

Immunity from danger had, as I have said, been long enjoyed by this particular pair, and it was with some compunction that I yielded at last to my instincts as a birds-nester, and resolved to exact the toll that seemed so ready to my hand. Had I indeed anticipated that any disastrous consequences might attend my raid I should certainly have abandoned the idea; but I argued from what I knew of their general disposition that there would be little likelihood of their home being deserted for any cause short of deliberate eviction. Accordingly at the time when I calculated that the eggs should have been laid, I secured a ladder (without the aid of which the hole was inaccessible), and armed with chisel and hammer ascended to commit the burglary. My intention was to enlarge the entrance sufficiently to enable me to insert a hand and investigate the interior; but I soon found that I had under-rated the difficulty of such a task. The wood was extraordinarily hard, and the mud defences themselves could hardly have been removed without tools; moreover the distracted owners, taking up positions within a few yards of me, never ceased to protest loudly and vigorously, and altogether showed such keen distress that I was more than once half inclined to desist. When, after two hours' hard work, the nest was brought within reach and proved to be empty, it almost seemed like a judgment on persecution. It only remained for me to do all in my power to repair the damage done, and some wet clay soon enabled me to reduce the hole to its original dimensions. Hardly had I descended to the ground when a blue tit appeared on the scene, and, perching for a moment on a rung of the ladder poked his head into the hole with characteristic curiosity. A few moments later, to my great satisfaction, I witnessed the return of the rightful occupants, who without further ado proceeded to complete my amateur work as a plasterer. So ended the first act of the drama; reference to my notebook shows that the date was April 17th.

For just a week the nest was left undisturbed, and then I made a second investigation. During the respite the rude clay had by some mysterious process, the secret of which the nuthatch seems to share with swallows and house martins, been hardened to the consistency of cement, the whole surface having been so scored all over by countless indentations of their beaks that it presented the appearance of elaborate stucco work. This time it was only the work of a minute to make a breach, and the results though not altogether successful, were on the whole satisfactory. A single egg was discovered in the nest; this I carefully replaced and a fresh supply of clay was utilized for the needful repairs. Once more the birds returned undaunted.

Now a fresh complication arose which quite altered the aspect of affairs. The next morning I was approaching the tree quietly to see how things were going on, when I caught sight of a bird, which proved to be a starling, busily pecking away at the entrance to the hole. The fact was that all the starlings in the neighbourhood were just then turning their thoughts to the business of nesting, and the sharp eyes of one pair had already discovered that this hitherto impregnable position had been tampered with, and that the clay while still damp and soft presented no insuperable barrier. Possibly they had witnessed the whole proceedings of the previous day and laid their plans accordingly. However that might be, I determined to defeat their object. Fetching my gun I cautiously stationed myself in hiding among the bushes beneath. I had not long to wait. A starling settled noisily on the top branch and was at once joined by another. There they commanded the situation, and their purpose was unmistakable; as I wished, however, to catch them *in flagrante delicto* I still awaited developments. Presently first one and then the other nuthatch returned for a moment to the tree, but scenting danger flew off again uneasily. An interval ensued during which the conspirators (myself included) remained motionless at their several posts, and then the female came back with a large bit of clay in her beak, and after flying round the tree once or twice alighted on the trunk on

the side sheltered from the view of the starlings. Gliding quickly down she suddenly slipped round to the hole, and was beginning hastily to attend to repairs, when one of the starlings with a harsh chattering noise swooped viciously down upon her. In less time than it takes to write the other nuthatch had come to the rescue, only to find the attack reinforced by the second starling. Taken at a disadvantage the nuthatches had to beat a retreat, and the original starling—the principal aggressor—stood screaming triumphantly at the mouth of the hole. At that instant I fired, and it dropped dead; on examination I was interested to find that it was a female. Once more the nuthatches gave a striking example of their intrepidity, for the report of the shot had hardly died away when they were both back at the tree resuming operations with as much apparent unconcern as if nothing at all had happened. I mounted guard a little longer and presently shot another starling on the tree, and by way of enforcing the lesson hung its body up within a few feet of the hole. Knowing, however, the pertinacity of these birds, I did not feel too sanguine even then that the mischief would go no further.

On the following day, when I went into the garden before breakfast, the first thing that met my eye was a nuthatch on the path in front of me where it was busily picking up mud. This it did by carefully detaching and rolling together a pellet about the size of a shilling, with which it flew off straight to the hole. A single glance at the latter more than confirmed my misgivings. The starlings had not only removed every trace of the protecting clay but had actually ejected the egg from the nest; the broken shell lay on the ground beneath. Undeterred by the grim scarecrow before them a number of these marauders had gathered on the scene and were apparently actively disputing the possession of so desirable a building site. Desperate but determined as ever, the nuthatches used most strenuous efforts to get the gaping hole plastered up afresh. But against such odds their present task was about as profitable as pouring water into a sieve, and it was only too obvious what the end must be. At this critical moment I hit on a plan by which I was able to befriend them to some purpose and make amends for the injury they had previously suffered at my hands. It was simple but effective. With the aid of a hammer and nails, I fastened a bit of wood securely over the hole in such a way as to leave it just large enough for the nuthatches; this was a rather unsightly makeshift, but a further application of clay served both to conceal the deficiencies in this respect and to restore the original character of the threshold. While this work was going forward, both nuthatches stood on the tree close beside me, and no longer uttered the notes of alarm which had been so incessant before. They lost no time in testing the result when I descended the ladder, and it was a comical sight to see the female's frantic contortions in squeezing through the hole which was now inconveniently small. This, however, was clearly a fault on the right side, and the nuthatches were after all left in possession of the field. The starlings were sensible enough to acknowledge defeat, but before doing so one individual (possibly the survivor of the original pair) planted himself at the mouth of the hole, and, thrusting in his head as far as possible, railed at the dauntless little inmate in unmistakable Billingsgate. Then he like the others decided to raise the siege, and peace reigned once more.

A whole fortnight passed, and the nuthatches toiled indefatigably to make good their own defences behind the improvised shelter which they evidently considered insufficient; certainly their previous experience might well justify misgivings as to my present *bona fides* in affording them protection. Eventually the traces of their labours could be seen extending inwards to a depth of more than six inches. During this period I observed that they generally repaired to one particular spot on the path in order to fetch their supply of mud, coming and going with such singular directness that, when one day I had inadvertently placed myself where I interrupted the traffic, I was startled to see the busy little worker pass and repass within a foot of my head with an absolute disregard of my presence. A well-known writer has indeed suggested from close observation of a tame nuthatch that these birds are peculiarly short sighted, and while the action I have mentioned does not necessarily support such a theory (which indeed it is hard to accept without further evidence) it has a certain interest as bearing on the question.

It is satisfactory to be able to record that this pair of plucky birds eventually brought off their brood triumphantly after all their persecution, and appear likely to enjoy for a long time to come the security that they have done so much to earn.

STANDARD SILVER: ITS HISTORY, PROPERTIES AND USES.—I.

By Ernest A. Smith, assoc.r.s.m., f.c.s.

At a very early period of the world's history silver was used as a medium of exchange, and also for domestic and public purposes.

Gold and silver appear to have been in general use as money from the time of Abraham, while vessels and ornaments of the precious metals were common in Egypt in the times of Usertsen I. (about B.C. 2433) and of Thothmes III. (about B.C. 1600), the contemporaries of Joseph and Moses.*

In ancient times the metals were used in their native or unalloyed condition, but alloys of definite composition or standard alloys were adopted for the purpose of coinage and also in the arts as early as B.C. 500, and probably earlier.

"The reasons for the use of alloys, in preference to pure metals, are somewhat complex. In early states of civilisation coins are generally made of more or less pure metal, but a nation does not advance far in its history before the very important fact is recognised that alloys are more durable than pure metals, and that their substitution for pure gold or silver affords a notable source of revenue.

"In cases where the coinage is in any degree international, the adoption of a low standard by one nation has to be followed by neighbouring nations, in order to prevent loss, and to facilitate commerce by avoiding the necessity for tedious calculations as to the rate at which coins may circulate in the respective countries."†

With regard to the actual standards of fineness or amounts of precious metal present in any given alloy which have from time to time been employed, it may

* Wilkinson's "Ancient Egypt," III., 225.

† Roberts-Austen, Cantor Lectures on "Alloys for Coinage," Society of Arts, 1884, p. 14.

be remarked that in the numismatic history of the world endless combinations of precious and base metals have been represented.

Gold and silver on account of their comparative softness and flexibility are never employed in a pure state, but are almost universally alloyed with a certain proportion of copper, the alloys being made up to definite proportions or "standards."

Although it is generally known that silver coins and plate are not made of pure silver, few people have very definite ideas as to the composition of the alloys which are employed for these purposes, and still fewer are aware that the amount of base metal added to the silver is guarded with the most rigorous care.

In the British Isles the proportion of silver in coin and plate is regulated by law. It is enacted that British silver coin and plate shall consist of 11 ozs. 2 dwts. of fine or pure silver and 18 dwts. of copper in the troy pound, or 925 parts of fine silver per 1,000 parts of alloy. This is termed sterling silver, and was first particularly defined by statute in 1576 (18th of Elizabeth, c. 15).

Many derivations have been offered with regard to the word sterling, but the most probable and the one now generally adopted is that given in a well-known old book entitled "A new Touchstone for Gold and Silver wares," published in 1679. In this very interesting work the author states (on page 8) that the expression sterling-alloy is derived "from the Easterlings, or men that came from the East part of Germany in the time of King Richard the First, and who were the first contrivers and makers of that alloy." The purity of their money was famous, and it is supposed that coiners were fetched from Eastern Germany to improve the British currency.

Stow, writing in 1603,‡ gives a similar explanation. He says "the money of England was called of the workers thereof, and so the Easterling pence took their names of the Easterlings, which did first make this money in England in the reign of Henry II., and thus I set it down according to my reading in Antiquitie of money matters, omitting the imaginations of late writers, of whom some have said Easterling money to take that name of a starre stamped on the border or ring of the penie; other some, of a bird called a stare or starling stamped on the circumference, and others (more unlikely) of being coined at Stiruelin or Starling, a town in Scotland."

With regard to the adoption of an alloy containing 11 ozs. 2 dwts. of silver in the pound troy as a standard for the silver currency of this country, Sir Roberts-Austen§ has pointed out that the adjustment of the relative proportions of the precious and base metals is undoubtedly guided by the particular system of weights used.

The fineness of alloys of silver has from very early times been computed by divisions of the troy pound, which weight is still retained in weighing gold and silver.

The Commissioners appointed in 1868 to enquire into the condition of the Exchequer Standards‖ state that "the troy pound is said to have been derived from the Roman weight of 5759.2 grains, the 125th part of the large Alexandrian talent, this weight, like the troy pound, having been divided by the Romans into twelve ounces," and they add, "the troy weight is universally allowed to have been in general use from the time of King Edward I. The most ancient system of weights in this kingdom was that of the moneyers' pound, or the money pound of the Anglo-Saxons, which continued in use for some centuries after the Conquest, being then known as the Tower pound, or sometimes the goldsmiths' pound. It contained twelve ounces of 450 grains each, or 5,400 grains, and this weight of silver was a pound sterling. The Tower pound was abolished in 1527 by a statute of King Henry VIII., which first established troy weight as the only legal weight for gold and silver. From that time to the present our system of coinage has been based on the troy weight."

In connection with the standard 925, it may be remarked that a Roman silver coin of the Triumvir Antoninus¶ (B.C. 31) had almost the same composition as British silver coin, as it contained — silver 925, copper 71, lead 2, and gold 1.

The standard 925 was probably first introduced into England by the Saxons, as the Saxon pennies were of the same standard. A number of coins issued before the Norman Conquest have been assayed by Roberts-Austen,** from which the following results have been selected. A coin of Burgred, King of Mercia (852-874 A.D.), contained only 332 parts of silver in the thousand, while one of Ethelred (978-1016 A.D.) contained 918 parts of silver, and was probably intended to represent the standard 925. A coin of Canute (1016-1035 A.D.) proved to be of the standard 931, and was also intended, in all probability, to represent the English standard.

Anglo-Saxon and Anglo-Norman coins are believed to have been of the standard 925; a coin of William the Conqueror when assayed proved to be of the standard 922.8. In England the standard 925 appears to have remained unchanged until the thirty-fourth year of King Henry VIII. (A.D. 1542), when, as will be seen from the following table, a great fall in the fineness took place.

TABLE showing the Alterations in Fineness of English Standard Silver, from the reign of William the Conqueror to that of Edward VII.

Date.	Reign.	Fineness of Silver.		
		In the Pound Troy.		Parts per 1000.
		ozs.	dwt.	
1066	William I.	11	2	925
to	to			
1542	34 Henry VIII.	10	0	833·3
1545	36 Henry VIII.	6	0	500
1546	37 Henry VIII.	4	0	333·3
1547	1 Edward VI.	4	0	333·3
1549	3 Edward VI.	6	0	500
1550	4 Edward VI.	3	0	250
1551	5 Edward VI.	5	0	416·6
1552	6 Edward VI.	11	1	921
1553	1 Mary	11	0	916·6
1560	2 Elizabeth	11	2	925
to	to			
Present Time	Edward VII.	11	2	925

‡ "A Survey of London," by John Stow, p. 52, 1603. Quoted by Roberts-Austen, p. 14, *Ibid.*

§ *Ibid.*, Cantor Lecture, p. 15.

‖ Third Report of Commissioners. Parliamentary Paper, c. 30, p. iii., 1870.

¶ "Die Metallurgie. Metallverarbeitung." A. Ledebur, p. 86, 1882.

** *Ibid.*, Cantor Lectures, page 17.

XUM

The table shows that in 1545 the standard alloy contained only one-half of its weight of pure silver, and in 1550 it was still further debased, and contained only one-fourth part of pure silver. The restoration of the silver standard, begun in the reign of King Edward VI., was completed by Queen Elizabeth, and it has not been since debased. *(To be continued.)*

THE TYPES OF SUN-SPOT DISTURBANCES.

By the Rev. A. L. CORTIE, S.J., F.R.A.S.

DURING the last twenty years some 3800 drawings of the solar surface, on a scale of 10½ inches to the sun's diameter, have been made at the Stonyhurst College Observatory, during the period 1880 to 1890 by means of the 8-inch equatorial, and since the latter year by means of the Perry Memorial 15-inch equatorial. The principal spots in this long series of drawings have recently been tabulated in a form which gives their complete life-histories from their first appearance to their final extinction. Accompanying the tabulations, are a series of charts which show at a glance the chief phases in the development of a group of spots. The object of these tables and charts was to compare individual spots on the sun and magnetic storms on the earth, and the results of the comparison were presented by Father Sidgreaves to the Royal Astronomical Society last December. But besides this primary object for which the tables and charts were drawn up, they have served, and, it is hoped, will serve for many other subsidiary studies with regard to sun-spots. One such study led to a paper read at the last meeting of the British Association at Bradford, of which some account is presented in the following pages. It is comparatively easy from the charts, not only to study the changes in individual spots which take place during their appearance on the sun, but likewise to compare outburst with outburst. From this comparison it was soon seen that there exists a great family likeness between all outbursts of sun-spots, whether we deal with the great storms when the solar activities reach their maximum, or the feeble manifestations of the solar forces at the epochs of minimum. Should an observer look at the sun at a time of maximum activity, he will probably see its surface covered with many spots seemingly in all sorts of forms and shapes; as scattered dots, or as trains of spots, or in a form in which two larger spots predominate in a group, or again as a single deep black spot, of round and regular outline. Yet all these varieties are but phases of one well-marked and general type through which, as a general rule, all groups of spots pass during the course of their life-histories. In a normal outburst the sequence of the phases is as follows. We must premise, however, that in short-lived spots all the various stages or phases of the type may not be reached, but only the earlier ones.

A group of spots first appears in the form of a few scattered dots or small spots. These spots grow with great rapidity, and in three or four days at the most after their birth, begin to aggregate, and reach a second characteristic phase in the process of development. This is marked by the predominance of two main spots in the group, one in the forefront, and the other in the very rearmost position of the group. In this phase the preceding of the two spots is for the most part the more compact and regular, its fellow being generally irregular and ragged in form, and made up of semi-detached patches of umbra and penumbra. Many times, however, it covers a greater total area than the leader of the group. This stage is reached by almost all groups of spots, even very small ones, and any theory as to the origin and development of sun-spots must needs explain why two spots, one in the forefront and one at the rear of the group should always predominate. The preceding of the two main spots, as a rule, then, rushes forward with a large proper motion in longitude, by this means increasing its distance from the rearmost spot. At this period in the life-history of the group, the space between the two spots becomes filled by a train of irregular unformed spots, and penumbral patches of no very great size, the whole train of spots thus formed arranging itself into a stream more or less parallel to the solar equator. This type is accordingly reckoned as the third in the order of succession in a normal outburst. It occurs ordinarily between five and seven days after the first appearance of the group. At times a retinue of companion spots follows both the chief members of the group, and more rarely is confined to the rearmost spot. This phase is not very stable or of long duration, and the two main spots survive after its disappearance. Hence there is a recurrence from the third type back again to the second. Of the two surviving spots the following one generally breaks up and disappears in a few days, leaving the leader to form into a dense black round spot of regular outline. This accordingly has been reckoned as the fourth type or phase in the stages of the life-history of a group of spots.

Although it is the leader that generally survives to form the single spot, yet instances are not wanting in which the reverse has been the case, the leader disappearing and the rearmost of the two spots remaining (*e.g.*, 1892, July 4—October 5). A few cases are on record when both the chief spots survived to form regular spots (*e.g.*, 1881, October 14—December 17). Again, the single surviving spot, accompanied or unaccompanied as the case may be by small companions, may never become a round regular spot, but may maintain an irregular shattered appearance of a collection of umbræ and penumbræ, as for instance in the great spot of February, 1892. The duration of the phase in which the group has developed into a single round black spot is generally for two solar rotations, and in one case (1897, April 28—August 27) was maintained for five successive rotations. It may be remarked in passing that the average life of a group of sun-spots, derived from a study of 115 greater disturbances recorded at Stonyhurst during the last twenty years, is 56 days, or a little longer than two solar rotations.

The last stage in the life-history of a group of sun-spots is reached when the round black spot gradually dwindles down to the dimensions of a mere dot, or disappears as a group of small dots. This phase is so like the opening phase of the series that it does not need a new type number to describe it. It frequently happens that when this final stage has been reached, other smaller spots will appear in the neighbourhood of the remnants of the storm that is passing away, and the whole cycle of phases will be again repeated. A series of outbursts linked together in this manner in approximately the same position on the solar disc was active during a period extending from September 25, 1891, to March 5, 1893, or during more than twenty solar rotations.

In addition to these four well-marked phases or types described above, another type comprises irregular, scattered groups, of short life, which occasionally appear and disappear without conforming to the normal sequence of changes.

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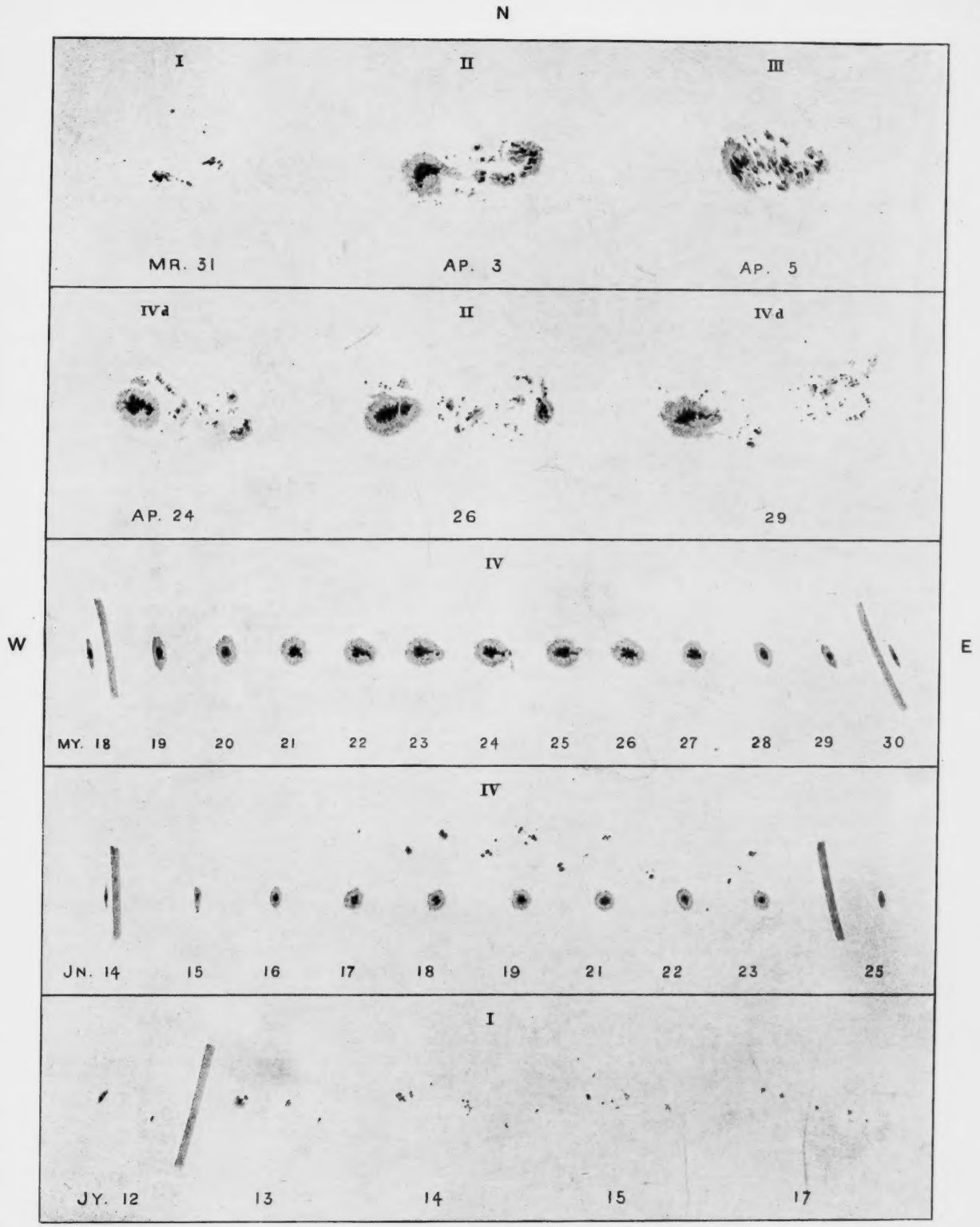

LIFE HISTORY OF A SUNSPOT GROUP, ILLUSTRATING FOUR TYPES.

From the Stonyhurst Drawings, 1884.

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Slight variations from the normal types, or subdivisions of the same, have so far been indicated by placing letters after the four type numbers.

The illustration, which shows not only the four types, but their sequence, is that of a large sun-spot group which first appeared on the sun on March 31, 1884, and lived for 108 days to July 17, passing the central meridian five times. The five horizontal sections of the plate correspond to the five rotations. The spot group was born at the centre of the visible disc on March 31, when it appeared as a few scattered dots, the first phase or Type I. of our divisions. By April 3 it had reached the phase, designated by Type II., when two main spots predominated. Thus it continued until the 5th, when the train appeared between the two spots, corresponding to Type III. On April 6th it was near the sun's western limb which it passed on the 7th. At its return it was first recorded on the 22nd, appearing on that date and on the three following days as an elongated single spot with a train of smaller companions. This phase is represented by one of the subdivisions of Type IV. On April 26th and the following day it had reverted to Type II., and on the 28th, 29th, and 30th to Type IV., subdivision *d*. Thus it remained until it again passed the western limb on May 4th. At its next two returns, when it was followed during each of the thirteen days that it was visible, it had become a single round spot, the normal spot of Type IV. It will be noticed that during the fourth appearance a small subsidiary group formed to the north of the original group, and that even in this small outburst the two spot type is evident. At its fifth appearance, when it was gradually disappearing, it had resumed the phase which belongs to Type I. A closer examination of the series of phases represented on the plate will show many other interesting points, as for instance the formation of tails to the leading spot of the group, and the narrowing of the penumbra on the side of the spot turned towards the sun's centre in rotation the third, even before it had reached a position near the limb where the effect of perspective would have been apparent. The illustrations are drawn to a scale of 10½ inches to the solar diameter.

In a subsequent paper the relation of faculæ to sun-spot groups will be dealt with.

CONSTELLATION STUDIES.

By E. WALTER MAUNDER, F.R.A.S.

V.—THE SCORPION AND THE SERPENT-HOLDER.

How many constellations did the original Chaldean Zodiac contain,—eleven or twelve? The question is a very important one as bearing on the origin of the Zodiac, since the twelvefold division is significant of the ancients having determined the length of the year at least approximately before the constellations were mapped out.

The assertion that the Chaldean Zodiac consisted originally of only eleven constellations is made explicitly by Servius the grammarian, in his commentary on the works of Virgil. The latter in his address to the Emperor Augustus, in the first Georgic, suggests that the space which lies between the Virgin and the following Claws, lies vacant for him; "the glowing Scorpion drawing back its arms and leaving for him a more than ample space of sky." Our Greek authorities, however, made the signs of the Zodiac twelve in number, but gave to one of the figures a double space; the Scorpion occupying one sign with its body and another with its outstretched Claws. Brown's explanation of this double honour given to the poisonous reptile is very ingenious. Quoting from Aratus, he points out the old legend of how Orion was slain by a gigantic scorpion in punishment for his attack upon Artemis:—

"And great Orion, too, his (the Scorpion) advent fears.
Content thee, Artemis! A tale of old
Tells how the strong Orion seized thy robe
When he in Chios, with his sturdy mace
A hunter, smote the beast to gain Œnopion's thanks.
But she forthwith another monster bade—
The Scorpion, having cleft the island's hills
In midst on either side: This, huger still,
His greatness smote and slew, since Artemis he chased.
And so 'tis said that, when the Scorpion comes,
Orion flies to utmost end of earth."

(Brown's *Aratus*.)

Orion, the most gorgeous of all the constellations, is, according to this theory, a stellar representation of the sun; the Scorpion, on the other hand, represents the night and the power of darkness. "As the huge size of Orion, *i.e.*, that of the sun as compared with the stars, is always insisted on, so the scorpions of darkness are of colossal size, infinitely greater than the Orion sun." The gigantic size of the Scorpion, therefore, was insisted on by bestowing on it a double portion of the Zodiac.

Our present name for the seventh constellation of the Zodiac, Libra the Balance, we owe to the Romans, Virgil writing in the first Georgic:—

"Libra die somnique pares ubi fecerit horas"

but we cannot now say how far back into antiquity the symbol goes. Though as Aratus truly says,

"Few are its stars for splendour and renown."

The constellation Libra can be readily found by an alignment from Arcturus:—

"Where yon gaunt Bear disports a tail, seek Alkaid at its tip,
From thence a ray athwart the space to south-south-east must dip;
And when Arcturus has been passed prolong th' imagin'd line,
'Twill mark a star, as far again, the first in Libra's sign."

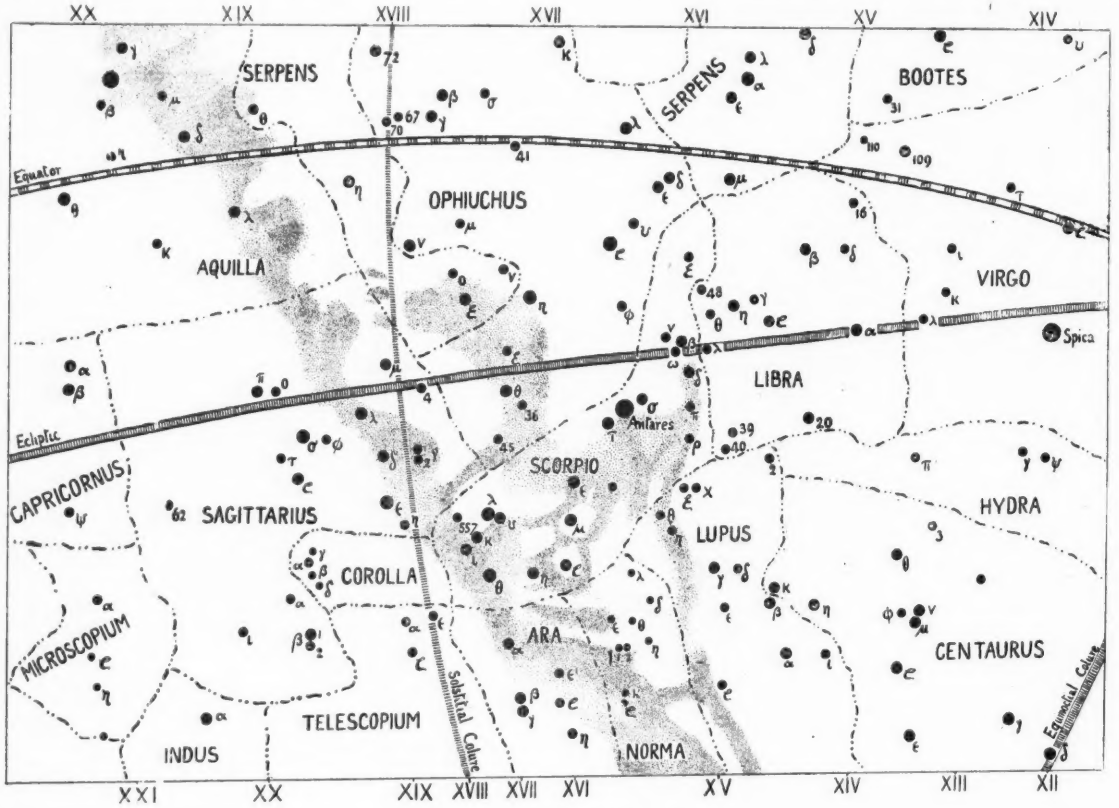
Alpha Librae is an unlucky star as to its name; it really should be Zuben el Genubi, the southern claw; but it is often called Zuben el Chamali, the northern claw, a title which clearly belongs to Beta Librae. The star marks the ecliptic almost exactly, and it forms a very pretty double to the opera-glass.

Beta Librae, forming an equilateral triangle with Alpha Librae and with Mu Virginis, is a star with a markedly greenish colour, and interesting history. For Eratosthenes calls it the brightest of all the stars in the Scorpion, that is in the double constellation, and Claudius Ptolemy gives it as equal with Antares. As it is now a full magnitude fainter than Antares it must have faded greatly.

But passing on to the Scorpion proper, we come to the finest region of the sky as seen in southern realms. There is no difficulty in tracing out the Scorpion. Antares, its brightest gem, is almost exactly as far beyond Spica as Spica is beyond Regulus; and Arcturus, Spica and Antares, make up a magnificent right-angled triangle, Spica marking the right angle. Antares stands in a long and beautifully winding curve, made of bright stars, which mark out the body and reverted sting of the reptile; and fainter stars to right and left show its legs. "There are few constellations," as Serviss truly remarks, "which bear so close a resemblance to the objects they are named after, as Scorpio. It does not require a very violent exercise of the imagination

to see in this long winding trail of stars, a gigantic scorpion, with its head to the west, and flourishing its upraised sting, that glitters with a pair of twin stars, as if ready to strike."

The pair of stars in question are Lambda and Upsilon, Lambda being the brighter. To the north and east of this pair of stars, and about 6° distant from Lambda, are two star clusters about 4° apart—6 and 7 Messier,—we come in turn to Tau, then after a gap to Epsilon, and then to Mu Scorpii, a lovely pair in the opera-glass, whilst the next star lower down in the curve, Zeta, gives a region of most exceptional beauty to a good binocular. To the English observer, Scorpii hugs the horizon too closely for the full magnificence of the region to reveal itself, but for those who are favoured with a more southern residence, the Milky Way attains



Star Map No. 5: The Region of Scorpio.

both well worth examination with the opera-glass. Turning back to Antares, the bright star to the west of it is Sigma, and almost between Sigma and Antares, but a little below, is another star cluster, number 4 in Messier's catalogue. The entire constellation is full of interesting and beautiful fields even for so slight an optical assistance as the opera-glass gives. The two principal stars in the forehead of the Scorpion are Beta the more northern, Delta the more southern, distant from Antares roughly one-third the way to Beta and Alpha Librae. Immediately below Beta is the bright and pretty pair, situated on the ecliptic, Omega Scorpii, whilst Nu Scorpii, a little above and following Beta, is also a double, but requires a more powerful lens to show it as such. Immediately above Antares is 22 Scorpii, a star with two companions; Rho Ophiuchi a little further north, has also a couple, both within the grasp of the opera-glass.

Following the curve of stars downwards from Antares,—which by the way owes its name to its pronounced red colour, the reddest bright star in the sky, and, therefore, fitly called Antares, the rival of Ares or Mars, here its greatest glory and its most striking complexity of form.

The old constellation makers have left evident proof in this portion of the sky that they were not working haphazard in the designs they selected for the star groups, and the places which they assigned to them. At midnight at the spring equinox, the Scorpion was for them on the meridian in the south, and the Dragon was in like manner on the meridian low down in the north. Just as they had planted the Kneeler, whom we now call Hercules, upon the Dragon in the north, so they provided another hero, the Serpent-holder, to trample down the Scorpion in the south, and the heads of the two heroes were made up by the stars in the zenith. Both the unknown warriors, therefore, were pictured in those primitive ideas as erect, but for many generations Hercules has been to us hanging head downwards in the sky in the most uncomfortable of attitudes, for our zenith, nowadays, passes nearly through his feet.

Although the conqueror over the Scorpion, Ophiuchus is not for a moment to be compared with his enemy as a constellation. It covers a great extent of sky, its stars

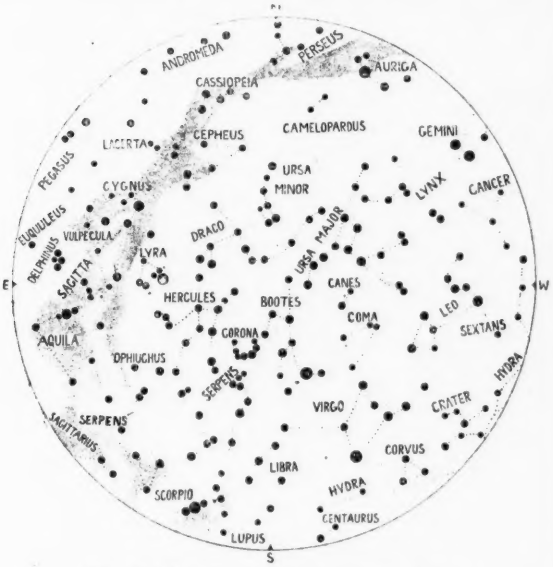
are none of them of the first rank, and are not disposed in any easily followed figures. Its principal star, Alpha, Ras-al-Hague, "the head of the serpent charmer," lies midway between Vega and Antares; as the old rhyme has it:—

"Through Ras al Hague, Vega's beams directs the enquiring eye
Where Scorpio's heart, Antares, decks the southern summer sky."

Ophiüchus is engaged on a double labour. Aratus describes him thus:—

"His feet stamp Scorpio down, enormous beast,
Crushing the monster's eye and platted breast.
With outstretched arms he holds the Serpent's coils;
His limbs it folds within its scaly toils;
With his right hand, its writhing tail, he grasps;
Its swelling neck, his left securely clasps.
The reptile rears its crested head on high
Reaching the seven-starred Crown in northern sky."

The head of the serpent is marked out by five stars in the shape of a capital X, immediately below the semi-



The Midnight Sky for London, 1901, May 6.

circle of the Northern Crown. The five stars are Beta and Gamma at the feet of the X, Kappa in the centre, and Iota and Rho at the top. The small stars clustering near this X of the Serpent's head make an interesting field to the opera-glass, but the tip of the tail, marked by the star Theta, is more interesting still. Theta may be found by drawing a line from Beta Herculis through Alpha Ophiuchi, and it is situated in a striking channel in the Milky Way, one side branch of which comes to an end just on the borders of Ophiuchus.

THE NEW STAR IN PERSEUS.

THE following is an abridgement of Harvard College Observatory Circular No. 56:—The cable message announcing the discovery of a new star in the constellation Perseus, by the Rev. T. D. Anderson, was received at the Observatory early in the evening of February 22, 1901. Owing to clouds, the new star was only occasionally visible, and twice it was necessary to cover the instruments on account of falling snow. During the intervals, however, various observations were made, which have a value owing to their early date.

Meanwhile, an examination was being made, by Mrs. Fleming, of the photographs of the region obtained here earlier in the month, with the various instruments. The photograph taken with the Cooke lens on February 19 had an exposure of 66m., beginning at 11h. 18m. Greenwich mean time. While this photograph showed not only the faintest stars contained in the Durchmusterung, but also stars as faint as the eleventh magnitude, no trace of the nova was seen. A photograph taken with the 24 inch Bruce telescope on October 18, 1894, with an exposure of 15m., shows no trace of this object, although stars as faint as the magnitude 12.5 are well seen.

The general appearance of the photographic spectrum (on February 22) resembled that of the Orion type and was very unlike that of the other new stars, in which the bright lines are the most conspicuous feature. This star had a long continuous spectrum traversed by 33 dark lines. On careful examination the lines 3970, 4102, 4341, 4481, and 4862 were seen to be bright on the edge of greater wave length. The line 4665 was bright on the edge of shorter wave length, or there was a bright line whose approximate wave length was 4660. On February 23, the clouds were so dense that few observations could be made. The spectrum was photographed faintly and showed no marked change except that the line K, which was absent on the previous evening, was present and nearly as intense as Hε. On February 24 the spectrum showed a remarkable change. It was traversed by numerous bright and dark bands, and closely resembled that of Nova Aurigae. The principal lines were dark with accompanying bright lines of somewhat greater wave length. The bright lines accompanying K and Hε were reversed, and traversed by narrow well defined dark lines. These last lines, and one of somewhat shorter wave length than Hβ, are the only sharply defined lines in the spectrum, all of the others being broad and hazy, and difficult to measure with accuracy. On February 25 the spectrum differed slightly from that of February 24. The lines Hδ, Hγ, and Hβ were also reversed and replaced by one or more narrow dark lines. On February 26 the changes in the spectrum were slight.

Observations of the position of the nova were made by Mr. J. A. Dunne, with the 8 inch meridian circle, on February 23, 24, and 25, with the result for 1900.0, R.A. 3h. 24m. 24·02s., Dec. + 43° 33′ 42·4″.

It therefore appears that on or before February 19, 1901, the star was invisible, or at least fainter than the eleventh magnitude. On February 21, its magnitude was 2.7, according to Mr. Anderson. On February 22, its magnitude was 0.5, perhaps becoming a little brighter on February 23, and then diminishing, so that on February 25 its magnitude was 1.1. Its spectrum on February 22 and 23 was of the Orion type, nearly continuous, traversed by narrow dark lines. During the next 24 hours an extraordinary change took place, so that on February 24 the spectrum resembled that of the other novæ. It was traversed by bright and dark bands, and the principal dark lines had accompanying bright lines of slightly greater wave length.

During the last fourteen years, and since the general application of photography to astronomy, eight new stars are known to have appeared: Nova Persei, in 1887; Nova Aurigae, in 1892; Nova Normae, in 1893; Nova

Carinae, in 1895; Nova Centauri, in 1895; Nova Sagittarii, in 1898; Nova Aquilae, in 1899; and Nova Persei in 1901. The second and last of these, which were much brighter than the others, were found visually by Dr. Anderson. All the others were found by Mrs. Fleming, from an examination of the Draper Memorial Photographs. EDWARD C. PICKERING.

In Harvard Circular No. 57, Prof. Pickering gives reproductions of photographs of a part of Perseus, one taken before the appearance of the nova and another when it far outshone all other stars in the field. The great change in the spectrum which took place between February 22 and 24 is also very forcibly illustrated by copies of the spectra photographed on these dates.

Numerous photographs have been obtained at the Yerkes Observatory, but details of the measurements have not yet been published. From a preliminary examination, Prof. Hale appears to be inclined to attribute the three principal green lines near F to the two nebular lines and magnesium *b*, but Sir Norman Lockyer considers that during the early stages these were really due to iron vapour at a high temperature.

The observations of magnitude which have been made by various observers indicate very remarkable fluctuations in the brightness of the new star. The rise from invisibility was even more rapid than could be assumed from the evidence of the Harvard plates. It fortunately happened that the region of the nova was photographed by Mr. Stanley Williams only 28 hours before the discovery by Dr. Anderson, and at that time the star was certainly below the 12th magnitude. The star thus probably rose not less than 12½ magnitudes within three days, corresponding to a multiplication of its light by 100,000 times.

From the time of maximum brilliancy on February 23 the decline was pretty rapid until about March 13 when the star was not far from 4th magnitude; then until the 17th there was a slow reduction to about 4.2, and the star remained near this until March 31st, except that on the 19th, 22nd, 25th, and 28th it went down to nearly 5.5. Thus, for a short time the star was a more or less regular variable, with a well-marked period of about 3 days. The expected recurrence of a minimum on March 31st, however, was not observed, but the oscillation has since been continued with a somewhat greater period and larger range of light changes. On account of these rapid changes it does not seem desirable to attempt the construction of a light curve until all the observations have been collected, and intending observers will see the importance of noting the hour as well as the day of observation.

The continued spectroscopic observations are of the utmost importance. Sir Norman Lockyer states that between the 10th of March and the 25th the photographic spectrum had greatly changed. Besides the persistent lines of hydrogen, there were lines due to helium, and others possibly identical with some of the lines in the spectra of bright line stars and nebulæ, the bright lines other than those of hydrogen seen in the earlier photographs having disappeared. In the visual spectrum it was observed that while the whole was becoming enfeebled, the bright hydrogen lines remained the most prominent feature, the other lines previously visible being much reduced in intensity, and apparently also being replaced by new ones, among which was a line in the orange (possibly D_3 replacing D). Another line in the green, near λ 501, which became relatively brighter, was probably the chief line of the nebular spectrum. A preliminary reduction of a photograph of the changed spectrum is thus described by Sir Norman Lockyer:—

λ 387	Broad and merging into Hζ 3889.
436	Faint.
447	Not very strong. Probably helium 4471.6.
456	Faint.
464	Very strong broad line. Possibly the 465 line of the bright line stars.
468	Moderately strong. Possibly new hydrogen, λ 4686, seen in bright line stars.
471	Weak. Probably helium, λ 4713.

The lines of hydrogen shown in the photograph were Hβ, Hγ, Hδ, Hε and Hζ. These exhibited a structure quite different from that shown in the earlier photographs, and the place of maximum intensity had changed from the more to the less refrangible side of the line in each case.

It thus appears that the spectrum has already exhibited three distinct phases. In the first (February 22 and 23) dark lines on a strong continuous background were the most prominent feature, and there is evidence that those not due to hydrogen and helium were high temperature lines of various metals. The second stage (February 24 to March 10) corresponded very closely with that of Nova Aurigæ before its assumption of the nebular condition, the spectrum consisting of bright and dark lines, and many of the bright lines having dark ones on their more refrangible sides. At the third stage, which commenced somewhere between March 10 and March 25, the spectrum consisted chiefly of bright lines, some of which were probably identical with lines which appear in the spectra of nebulæ and bright line stars. Father Sidgreaves appears to have discovered variations of spectrum accompanying the changes of magnitude which have occurred since the middle of March, but details are not yet available. In the case of Nova Aurigæ, only the second of these stages appears to have been recorded, the transition to the more complete nebular condition indicated by the third stage of Nova Persei either having been very sudden or having escaped detection from other causes.

It will thus be seen that there is every reason to hope for great additions to our knowledge, when full details of the observations become available for discussion.

A. F.

Letters.

[The Editors do not hold themselves responsible for the opinions or statements of correspondents.]

SUNSPOTS AND TERRESTRIAL TEMPERATURE.

TO THE EDITORS OF KNOWLEDGE.

SIRS,—In comparing the temperature-tables for the last 20 years, I have been struck by the fact that our temperature is surprisingly dependent on the number of sunspots on the sun. The winters during and after a sunspot minimum are notably colder than the average, while the winters during and after a maximum are on the whole of a mild nature. Now presuming that this is not an accidental coincidence, which it seems to me is most improbable, as during the last 50 years the same striking connection meets us nearly everywhere, the cause of this mysterious connection seems very inexplicable according to the hypothesis that solar spots are excavations in the sun, produced by an eruption of gases, which become highly condensed, and therefore

appear to our eyes as dark spots. In that case these spots would in no way send forth any extra quantity of heat, on the contrary, they would diminish the heat-giving surface of the photosphere. But according to all statistics this by no means agrees with our observations.

Now I saw in the November number of KNOWLEDGE for 1900, p. 254, that Baron Kaulbars had brought forth a new hypothesis on the nature of solar spots. The Baron indicates that as the sun's temperature in all probability rises the deeper one descends, "the lower layers, which we see through the openings of the spots, must be much hotter than the photosphere, and as such their immense temperature produces vibrations of the ether of so great a rapidity, and such minuteness of wave length, that they are out of range of sensibility of our optic nerves, and therefore appear black." If this be the case, it gives a simple explanation of the rise and fall of the temperature of our seasons, in accordance with the sunspot cycle. At a maximum the large amount of spots would send forth an excess of heat, and at a minimum the sun's temperature would be normal.

Of course our temperature is subject to manifold terrestrial disturbances, wherefore no absolute regularity can be expected to be attained in evidence of a close connection between the sunspot cycle and our waves of heat and cold, but still the above statements seem to afford some degree of presumption as to the likelihood of such a connection. PERCY QUENSEL, T.F.K.

Upsala, Sweden.

[Mr. Quensel states that he has "been struck with the fact that our temperature is surprisingly dependent on the number of sunspots." It is much to be desired that Mr. Quensel should give the actual figures on which he bases this statement. Right or wrong, it is not a statement that can be accepted on anyone's *ipse dixit*, but we do need most sorely the fullest and fairest possible comparison of temperature records with the observed sunspot curve. It must be borne in mind that if the spots radiated absolutely no heat whatsoever yet the change from the maximum to minimum would hardly mean a change of one-tenth per cent. in the solar radiation. Now we know that the radiation from a spot is very considerable. The radiation from the faculæ—most numerous when spots are most numerous—is probably in excess of that from the photosphere. We may take it then that the extreme variation from dead minimum to most active maximum in the total radiation of the sun is not likely to exceed one part in ten thousand. One would scarcely expect that so small a change would produce a very marked result upon our temperature curves. If Mr. Quensel has a clear case of such connection, we should certainly be glad to see it.

E. WALTER MAUNDER.]

THE NEBULAR HYPOTHESIS.

TO THE EDITORS OF KNOWLEDGE.

SIRS,—Mr. Walter Maunder's observations in the April number of KNOWLEDGE are certainly not in accordance with the theory propounded by Laplace. I have always been given to understand that Neptune, if that body really determines the boundary of the solar system, was the first planet to be detached from the parent mass which was then (supposed to be) in a rapid motion of rotation about a central axis. If this state of things represents the true facts, then Mercury is the youngest of the planets, and not the oldest, as Mr. Maunder seems to suggest. GEO. MCKENZIE KNIGHT.

7, Sydenham Terrace, Louth, Lincs.

TO THE EDITORS OF KNOWLEDGE.

SIRS,—Perhaps I may be allowed to refer your correspondent Mr. Christopher to Trowbridge's explanation of the anomalous rotation of Uranus and Neptune, as given on pp. 570 and 571 of the new edition of Professor Young's "General Astronomy," as affording to my mind a more simple and rational explanation of the difficulty than that furnished by Faye's more involved one.

WILLIAM NOBLE.

Forest Lodge, Maresfield, Uckfield.

[It may be pointed out that Mr. Maunder, who has proceeded to Mauritius to observe the coming solar eclipse, simply quoted Faye's modification of the nebular hypothesis as a possible way of explaining some of the facts which have come to light since the time of Laplace, and is in no way responsible for the suggestion that the interior planets are the oldest, as Mr. Knight's letter seems to imply. On the contrary, it was remarked that there were very considerable difficulties attaching to Faye's form of the theory.

The explanation to which Captain Noble draws attention will also be found in the first edition of Young's "General Astronomy," pp. 518, 519. The substance of it is that when a ring has been detached and concentrated into a single mass, the direction of axial rotation will depend upon the original distribution of matter within the ring; if of uniform density, the rotation would be retrograde, but if it were most dense near the inner edge, the rotation would be direct. Prof. Young goes on to say: "The fact that the satellites of Uranus and Neptune revolve backwards is not, therefore, at all a bar to the acceptance of the nebular hypothesis, as sometimes represented."—EDS.]

CONSTELLATION STUDIES.

TO THE EDITORS OF KNOWLEDGE.

SIRS,—I have been very much interested in Mr. E. Walter Maunder's "Constellation Studies" in your valuable paper, and would like to ask two or three questions, trusting to receive a reply through your columns.

In the February number, Mr. Maunder, writing of the Constellation Leo, says that "Gamma, Zeta and Epsilon are all interesting as opera-glass objects from the companions which a slight optical assistance brings into view." The Rev. T. W. Webb, in his list of double stars, gives the distance of the component stars of Gamma Leonis as only 2·5″ apart. Would an opera-glass split this star?

On looking at Captain Smythe's "Bedford Catalogue" I find the two stars of Epsilon Leonis are only 1·9″ apart. Surely no opera-glass could divide these?

The smaller of the component stars of Epsilon Leonis is of the 10th magnitude only. Could this be seen with an opera-glass, even if the distance from the larger star were greater? Would not the light be much too dim?

In the March number Mr. Maunder says that "Zeta Corvi, the faint star midway between Epsilon and Beta (Corvi), shows with the opera-glass as a very interesting double." Now the smaller star of this pair is 13·8 magnitude. I should like Mr. Maunder to say whether it would be possible to see a 13·8 magnitude star with an opera-glass, whether indeed it would not be a difficult object for a small telescope? ERNEST L. BEILBY.

West Bridgford, Notts

[The "companions" mentioned by Mr. Maunder in connection with the stars to which reference is made by Mr. Beilby, are small adjacent stars, and not the "components" shown when large telescopes are employed. Certainly no opera-glass would divide stars 1·9″ or 2·5″ apart, nor could it be expected to show stars of the 10th magnitude. An aperture of at least 10 inches would be required to see a star of magnitude 13·8.—EDS.]

Notices of Books.

"THE PROGRESS OF INVENTION IN THE NINETEENTH CENTURY." By Edward W. Byrn, A.M. (New York: Munn and Co.) Illustrated. 3 dols.—This book compels our admiration. Beautifully printed on excellent paper, and very tastefully bound, it is a pleasure to behold. The illustrations too, are good and most interesting, comprising, as they do, pictures of the people of 100 years ago engaged in various mechanical pursuits. The author realising the limitations of his work, states in his preface that "The work cannot claim the authority of a text book, the fulness of a history, nor the exactness of a mechanical treatise." Under the heading "Chronology of leading events" we have, 1800, Volta's chemical battery, and Roberts' machine for making continuous webs of paper. In 1801, Trevithick's steam coach, and so on. Of the telegraph we are told, "On May 24th, 1844, there went over the wires between Washington and Baltimore the first message, 'What hath God wrought?'" This is, of course, an error, for as far back as 1820 Fletcher made use of his electro-magnetic telegraph. But the rest of this chapter is accurate and interesting. Under "The Dynamo and its Applications," we are, of course, not justified in expecting anything other than the well-known history from Pixil's work in 1832 to the machines of to-day. Next, from the description of Barlow's wheel, we are taken, by easy stages, to some account of the modern Westinghouse motor, and, turning the pages again, we go from the Jaberkoff candle to the search-light on Mount Lowe. Under "The Steam Engine," we have a description and picture of Hero's engine, assigned to the year 150 B.C. Turbines, the Nasmyth hammer, and the modern fire engine, are all depicted and described. Locomotives and Atlantic liners, printing presses, and paper machinery, are all pleasantly discoursed of. The typewriter, sowing and sewing machines, refrigerating apparatus, and motor cars, are all adequately represented, as also the bicycle at various stages of its evolution. Telescopes, cameras, radiographic apparatus, and gas plant, all make way for the Forth Bridge, which is followed by the Suez Canal, the Eiffel Tower, and Washington's Monument, wood and metal working appliances and firearms. Our author concludes with an excellently well-written "Epilogue," and we lay the book down wishing that we might have ever so brief a look into any similar work which may be published in A.D. 2000.

"MICHAEL FARADAY: HIS LIFE AND WORK." By Prof. S. P. Thompson, F.R.S. (Cassell and Co.) Illustrated. 2s. 6d.—A hackneyed verse of Longfellow's "Psalm of Life" forces itself upon the mind when a book like the present comes before us. For to a student of science, or anyone having a mild interest in natural philosophy, the life of a man like Faraday is an inspiration. And when such a biography as his is available at the low price of this one, it is almost justifiable to say that the possession of the book should be everyone's desire. The general facts of Faraday's career are well known. How he attended Davy's lectures at the Royal Institution while a bookbinder's apprentice; how he brought himself under Davy's notice and was appointed to a minor post in the Institution, from which position he rose to be the leader of British science and the beacon of his time—all these facts are common knowledge. The story is told by Prof. Thompson in a most sympathetic manner, and there is scarcely a page of the book that does not contain some interesting incident or expression of opinion. There are few men whose lives will bear such minute analysis as that of Faraday, and none a student of science could more profitably keep before him. When we read how Davy treated the assistant whose researches had excited the admiration of the whole scientific world, a spirit of indignation fills the mind, and it is difficult to admire the genius of a man who could play such a part. The unpleasant light in which Davy's action can now be seen should be taken to heart by the men of science in power in the present generation. There may not be many Faradays, but there are certainly a number of Davys who endeavour to keep their assistants, however capable they may be, in subordinate positions. Faraday was above all petty meannesses and minor jealousies of this kind, and his life was one which should be widely known and emulated.

"THE STRUCTURE AND LIFE-HISTORY OF THE HARLEQUIN FLY (CHIRONOMUS)." By Prof. L. C. Miall, F.R.S., and A. R. Hammond, F.L.S. (Clarendon Press.) Illustrated. 7s. 6d.—This is not a book which appeals to a large public, yet it is a very valuable one, and will take rank as an important contribution to natural history. The work is very appropriately published by a University Press, and we trust that many similar monographs will be made available. What are popularly known as blood-worms are the larvæ of the gnat-like flies often seen in summer on window-panes, or hovering in swarms over streams and pools. This is the insect the life-history of which is traced by the authors in detail. To the practical man, it may appear a waste of time and money to prepare and publish a work upon the structure and habits of a trivial insect, but if he were familiar with the working out of the connection between malaria and mosquitoes he would pause before giving expression to this view. If the life-histories and internal structure of the various mosquitoes had been thoroughly studied, the connection between the insect and the disease would have been understood long before it was. In the same way Chironomus is possibly connected with occurrences in nature which affect the well-being of the human race directly or indirectly, and, leaving the biological value of the monograph upon it out of consideration, the time will probably come when its practical significance will be understood. From another point of view the book is valuable. There is a tendency to consider it an achievement to add to the number of species, while the study of the life-histories of insects is neglected. The monograph should encourage a more scientific spirit among the members of natural history societies, and lead to the preparation of works of a similar character. How wide is the field may be judged by the remark that "The great majority of Dipterous insects, for instance, have never been reared, and only an insignificant minority have been closely examined." We venture to say that a large part of the book will provide a naturalist with novel and interesting information, and will suggest similar observations of other insects, as well as create a desire to examine practically the facts described. If local natural history societies will encourage work on these lines they will do a real service to biological science.

"THE TEMPLES AND RITUAL OF ASKLEPIOS AT EPIDAUROS AND ATHENS." By Richard Caton, M.D. (C. J. Clay.) Illustrated. 3s. net.—Among the interesting results of archæological research in Greece is the information obtained as to the sanitary and medical aspects of Greek life by the exploration of the shrines of Asklepios, the god of healing, at Epidauros and Athens. Dr. Caton brings together the work that has been done by various archæologists at the sites of these shrines, and contributes to it some observations, restorations and theories of his own. His book contains the substance of two lectures delivered at the Royal Institution, and is well illustrated. The purposes of the various buildings are described or conjectured, and the ritual of the Asklepian shrines, as well as the accommodation and treatment of the sick who frequented them, are considered. A number of large and harmless yellow snakes were kept in the sanctuary, and one of Dr. Caton's original suggestions is that the labyrinth below the beautiful Tholos or Thymele temple may have been the home of these creatures, which were reverenced as the incarnation of the god, and were utilised in the treatment of the patients. We read "The sick were delighted and encouraged when one of these creatures approached them, and were in the habit of feeding them with cakes. The serpents seem to have been trained to lick with their forked tongues any ailing part. The dog also was sacred to Asklepios, and the temple dogs in like manner were trained to lick any injured or painful region of the body." Three centuries before the commencement of the Christian era the rulers of Rome sent a galley to Epidauros to fetch the god Asklepios to check a pestilence. One of the sacred serpents was carried in the galley, and it left the ship as soon as the insula in the Tiber was touched. The plague is said to have disappeared at once, and in gratitude to the god which was believed to be present in the form of a serpent, a temple was erected to Æsculapius, as the Romans designated him, and from that time this island in the Tiber has been devoted to the cure and treatment of the sick. Moreover, adds Dr. Caton, "It is doubtless, in consequence of this episode of the foundation of the temple of Æsculapius on the island of the Tiber, that the staff and serpent of the Epidaurian god have been, and remain to this day, the symbol of the profession of medicine." These remarks are sufficient to show that the book is of real interest in connection with the history of medicine, and merits the consideration of students of classical archæology.

"ONE THOUSAND OBJECTS FOR THE MICROSCOPE, WITH A FEW HINTS ON MOUNTING." By Dr. M. C. Cooke, M.A. (Frederick Warne and Co.) Illustrated. 2s. 6d.—Dr. Cooke's descriptive guide to microscopic objects easily accessible and possessing characteristics worthy of observation has been a helpful friend to many microscopists. In its new form the book should be even more successful, for the introductory part now given contains just the kind of information as to the miscroscope and its essential accessories, and the manipulation, collection and mounting of

objects, most needed by everyone taking up microscopy either as a source of mental recreation or as a serious study. It must be borne in mind, however, that the casual examination of a variety of natural objects is of little use unless the observer has a good memory and can bear in mind the specific characteristics of the things he sees. To be of value it is necessary to make notes and to compare the structures and organs of various plants and animals with one another, or to devote attention to one particular organism and find out as much as possible about it.

"IMITATION: OR THE MIMETIC FORCE IN NATURE AND HUMAN NATURE." By Richard Steel. (Simpkin.)—This book belongs to a class the virtues of which are best appreciated by the individual authors. A number of similar books have been published and they are all the despair of the reviewer, who desires to do them justice so far as the limitations of time and space will permit. It is, however, practically impossible to describe satisfactorily the argument set forth or to submit the contents to minute criticism. So far as we are able to make out, Mr. Steel aims at the apotheosis of the imitative faculty in organic and inorganic nature. Every biologist knows that mimetic force is an important factor in the organic development, and it would be possible to exemplify its action by many cases. Mr. Steel deals with imitation in animal and vegetable life, but this subject only occupies a small part of his book. In the remaining part he gives reasons for believing that the influence of imitation is very great in other ways, and indirectly affects almost every aspect of bodily, mental and spiritual activity of man; in fact, practically every thing and phenomenon in the realm of natural and abstract philosophy, from the law of gravitation and the use of a silk hat, to the conception of a First Cause, is shown to depend upon the tendency to imitate. To some of the cases stated in support of this thesis no objection need be raised, but others will not so readily meet acceptance, and the want of precision of the whole makes the reading of the book wearisome to people who are used to concise statements of fact.

"RAILWAY RUNS IN THREE CONTINENTS." By J. T. Burton Alexander. (Elliot Stock.) 7s. 6d. net.—Engineers and others connected with railway working will find this volume very handy for reference, as it contains a record of actual performances on some European, Canadian, Australian and American lines, as observed by the author while riding on the engine or in the train. From the times given for each run we see at once how far the time-tables of the various companies are adhered to in actual running, and on which lines time is best kept, or, if lost, regained. Particulars are also given as to the load drawn, and the class of locomotive used. The book is thus one which, while technical in its subject, is worth bearing in mind as containing a compact statement of the relative performances of many celebrated trains in various parts of the world.

"PRIMER OF ASTRONOMY." By Sir Robert Ball, LL.D., F.R.S. Cambridge: University Press. 1s. 6d. net.—It is not very easy to write an elementary text-book in astronomy which will have many points of originality. The most we can expect is that it should be well written, well arranged, and have clear and full explanations of the different departments of the science. Judged by this standard, we have nothing but praise to offer to this little work. It is written with the command of the right word and the right expression that is so characteristic of Sir Robert Ball's style; the arrangement is very fair; and Sir Robert goes deeper and more fully into the various branches, both fundamental and physical, of astronomy than the dimensions of the book would have led one to expect.

"HAND-BOOK OF PRACTICAL BOTANY." By Dr. E. Strasburger. Translated and edited from the German by W. Hillhouse, M.A., F.L.S. Fifth edition. Re-written and enlarged. (Swan Sonnenschein.) Illustrated. 10s. 6d.—A new English edition of Professor Strasburger's well-known "Das Botanische Praktikum" is a welcome addition to botanical literature. Three years ago the author published a third edition of the German work, from which Professor Hillhouse has prepared the volume before us. The author's name is a sufficient guarantee of the excellence of the work, which is designed for the student of microscopy, as well as for those who desire to study the structure of plants from a more distinctly botanical point of view. It has been accessible to English readers since 1886, and few of the numerous treatises on practical botany are better known and more thoroughly appreciated in English laboratories. The directions are given in great detail, and the materials required are not beyond the capabilities of small institutions, and may be obtained without difficulty by the isolated worker.

The fifth edition contains some additional matter and has undergone other changes at the hands of the English editor. The translation is less literal and the English freer and more pleasantly readable than formerly—a change which will be favourably received. The appearance at the head of each chapter of the list of reagents, as well as of the plants required, will be found a great advantage. We think it a matter for regret that the editor has decided to omit the references to literature which were appended to each chapter in the earlier editions. Many, perhaps the majority, of those who use the Hand-book will not suffer from the omission, but to others who used it as an introduction to more advanced botanical work these references were of considerable value. The important divisions of the chapters are indicated by italicised headings to the paragraphs, which will greatly facilitate reference, the need of which was frequently experienced in using the earlier editions. We have no doubt that this volume will quickly be as well represented on the work-benches of botanical institutions as its predecessors have been.

"THE COMPLETE WORKS OF JOHN KEATS." Edited by H. Buxton Forman. In five volumes. (Glasgow: Gowans & Gray.) 1s. each. The fourth volume of this scholarly edition of the works of Keats is now issued, and in welcoming it for the complete character of its text and the elaborate detail of its notes and marginalia, we cannot too highly commend the attempt of the publishers to give the public an edition of the English classics which is irreproachable as to the correctness of its text, altogether admirable in its form and style, and at the same time quite inexpensive. It would be ungracious in the presence of so erudite an editor as Mr. Buxton Forman to raise any objection to the profusion of his notes, but we are strongly of opinion that there is a distinct danger of overlaying the poet by the notes, having regard to the object of a popular edition, as the general reader is so easily dissuaded, and it may become a task instead of a pleasure to extricate your poet from a redundancy of notarial lore. Let the poet speak for himself, and dispense with the chorus as far as possible.

"JOURNAL OF THE SOCIETY OF COMPARATIVE LEGISLATION." (John Murray.) 5s. We have received from Mr. Murray the sixth volume of the new series of this invaluable journal, containing an exhaustive review of the Legislation of the British Empire for 1899; a brief memoir of the late Lord Chief Justice (Lord Russell of Killowen), from the pen of Mr. Joseph Walton, Q.C.; and a preliminary study, by Sir Frederick Pollock, of the history of the Law of Nature. We observe among the notes some interesting excerpts from the "Cape Law Journal" (now the "South African Law Journal") on some of the many novel questions raised in connection with the unhappy war with the two Boer Republics.

"AGRICULTURAL ZOOLOGY." By Dr. J. Ritzema Bos. Translated by J. R. A. Davis. Second edition. (Methuen.) Illustrated. Price 3s. 6d.—The first edition of this excellent little work was published in 1894, and the comparatively early date at which a second has been demanded bears testimony to its usefulness and that it supplies a long-felt want. The present edition, besides a careful revision of the text, differs from its predecessor by the addition of an appendix, which consists mainly of a translation of the introduction to a larger work on the same subject by the author, and likewise a classification of agricultural pests according to habitat. An index is also an all-important addition. The work gives a systematic survey of all the groups of the animal kingdom which can be said to affect agriculture in any way, either injuriously or beneficially. And although in certain respects the classification employed is somewhat antiquated, while some of the illustrations might be better, this conspectus has been well carried out, and is written in a style free from unnecessary technicalities, so that it may be understood without much difficulty by the intelligent farmer and gardener. The original German work described, of course, all the animals met with on the Continent which affect agriculture; in the English editions some of the non-British species are printed in small type, and it would have been better, we think, if the same distinction had been applied in all cases, *e.g.*, the corn-mouse (p. 41). It may be added that neither author or translator appears to be aware that the pine-marten (p. 26) is not a British species. Moreover, we must deplore the inclusion of the swift and the swallow in a single family (p. 58), as tending to perpetuate a misconception of affinities. But, after all, the agriculturist is more concerned with invertebrate than with mammalian pests, and we have nothing but commendation to bestow on that portion of the work dealing with insects, "flukes," etc. Indeed the section devoted to the life-changes of the liver fluke and its kindred is excellent, and can scarcely fail to arouse the interest of the farmer who has hitherto been acquainted with this malignant pest in a single phase of its chequered career. Seeing, however that Miss Ormerod, in her introduction, has bestowed unstinted praise to this portion of the work, it would be almost an impertinence on our part to attempt further commendation.

BOOKS RECEIVED.

The Birds of Siberia. By the late Henry Seebohm. (Murray.) Illustrated. 12s. net.

The Romance of the Heavens. By Prof. A. W. Bickerton. (Swan Sonnenschein.) Illustrated. 5s.

Arsenic. By Prof. J. Alfred Wanklyn, M.R.C.S. (Kegan Paul.) 2s. 6d.

The Design and Construction of Oil Engines. By A. H. Goldingham, M.E. (Spon.) Illustrated. 6s. net.

The Elements of Darwinism. By A. J. Ogilvy. (Jarrold.) 2s. 6d.

The Colour Cure. By A. Osborne Eaves. (Wellby.) 1s. 6d. net.

Twentieth Century Inventions: A Forecast. By George Sutherland, M.A. (Longmans.) 4s. 6d. net.

Elementary Practical Mathematics. By M. T. Ormsby. (Spon.) Illustrated. 7s. 6d. net.

Disease in Plants. By H. Marshall Ward, SC.D., F.R.S. (Macmillan.) 7s. 6d.

A Text-Book of Sciography. By John H. A. M'Intyre, M.I.M.E. (Blackie.) Illustrated. 3s. 6d.

The Elements of Differential and Integral Calculus. By J. W. A. Young and C. E. Linebarger. (Hirschfeld Bros.) 10s. 6d. net.

The Structure and Inherent Motions of the Universe. By Edward Meyer. (Adelaide: A. & E. Lewis.)

Familiar Wild Birds. Part I. By W. Swaysland. Illustrated by A. Thorburn and others. (Cassell.) 6d.

The Photo-Miniature. Vol. II., No. 24, March, 1901. (Dawbarn and Ward.) 6d.

Stonyhurst College Observatory: Results of Meteorological and Magnetical Observations. (Clitheroe: Parkinson and Blacow.)

Whist Dialogues. By Major Jack Tenace. (Bruxelles: E. Wagemans.)

A Natural System of Map Drawing. By Prof. A. W. Bickerton. (Swan Sonnenschein.)

The Scientific Roll: Bacteria. By Alexander Ramsay. (R. L. Sharland.) 1s.

A La Conquête du Ciel! F. C. de Nascius. (Nantes: A. Dugas.)

The Use and Abuse of the Harrogate Mineral Waters. By Arthur Roberts, M.D., M.R.C.S. (Harrogate: Robert Ackrill.) 6d.

Archives of the Roentgen Ray. August, 1900, and January, 1901. (Rebman, Ltd.) 4s. net.

ASTRONOMICAL.—An account of a new astronomical undertaking of great magnitude has recently been given by Professor Auwers. The object is nothing less than to collect into one great catalogue the determinations of the positions of stars which have been made during the last one hundred and fifty years, and to reduce them all to the equinox of 1875. At the present time the observations are distributed through more than three hundred catalogues, and much time is lost in consulting these different sources of information and in correcting the positions for the epoch required. It is estimated that the total number of star places to be dealt with will be about a million, and proper motions will be investigated whenever possible. The work is to be undertaken by the Berlin Academy of Sciences, which received a permanent endowment for it during the bicentenary celebrations last year. Dr. F. Ristenpart has been appointed chief of the computing staff, and the work will be under the general superintendence of a committee of which Professor Auwers is president.

The presence of free hydrogen as a normal constituent of our atmosphere to the extent of about two volumes in ten thousand, has been demonstrated by the experiments of M. Armand Gautier. The result is of great interest in connection with Dr. Johnstone Stoney's views as to the tendency of gases to escape from the atmospheres of planets when their molecular velocities are great enough to overcome the gravitational attraction. On this view the earth cannot retain hydrogen, but there is of course a possibility of its continued production. Professors Liveing and Dewar, who have previously found free hydrogen in air, suggested that there might be a continued accession of hydrogen from interplanetary space.

A suggestion made by Lord Rayleigh in 1893 to the effect that in astronomical photography the plates should be accommodated to the telescopes rather than telescopes to the plates, has recently been acted upon with complete success at the Yerkes Observatory. Photographs taken with the great refractor (which is corrected only for the visual rays) on isochromatic plates, through a suitably-coloured screen, are perfectly defined, and the large scale greatly augments their value for purposes of measurement. Pictures of the star cluster in Hercules and of portions of the moon's surface show a great amount of detail.—A. F.

BOTANICAL.—The force exerted by swelling seeds has been demonstrated by experiments made by Dr. D. T. MacDougal, who has published the results obtained in the March number of the *Journal of the New York Botanical Garden.* It was ascertained by means of a manometer that peas, on being wetted, exerted a pressure sufficient to compress a column of air from a length of 6·30 to ·78 inches, which is equal to eight atmospheres, or 120 pounds to the square inch.

Herr von Minden has a paper in the last published part of *Flora* on the irritability of the style in two species of *Arctotis* (*A. aspera* and *A. calendulacea*), which recalls that exhibited by the column in species of *Stylidium*, and which is doubtless concerned in the function of pollination. It was observed that the style on being touched by a needle, or the body of an insect, immediately became strongly concave on the side touched, so that the stigmas, which had received a coating of pollen on the outside during their passage through the staminal tube, would come in contact with the irritating agent, to which, in the case of an insect, some pollen would be conveyed.

In *Hooker's Icones Plantarum*, Vol. xxvii., Part 4, Mr. Hemsley continues his revision of the genus *Sapium*, to which belongs the tree that produces the Colombian india-rubber of commerce. Eight species are described, five of them being new. The Peruvian *Castilloa australis* is described and figured in the same work. This plant yields caoutchouc, like the well-known *C. elastica*, the chief source of Central American india-rubber.

Das Pflanzenreich is the title of a colossal work which is now being published under the editorship of Dr. Engler, of Berlin. The three parts already issued consist of monographs of the Musaceæ, Typhaceæ, Sparganiaceæ, and Pandanaceæ. The plan of the work, which, it is anticipated, will take twenty years to complete, is somewhat the same as that followed in Engler & Prantl's *Pflanzenfamilien*, but in *Das Pflanzenreich* species, subspecies, and varieties are described as well as orders and genera. The concise descriptions are supplemented by illustrations of the more characteristic species.—S. A. S.

METEOROLOGICAL.—In the present state of knowledge and opinion, the new meteorological journal, *Climat*,* strikes one as rather a bold venture. It explains weather

* Published in St. Petersburg, Nevsky, 88, in four languages. Twice a month. Agents for British Isles: Hugh Rees, Limited, 124, Pall Mall, London, S.W. 16s. per annum.

by the moon, and not only so, but undertakes to supply forecasts of weather some weeks ahead at a host of stations in the northern hemisphere. The editor, M. Demtchinsky, gives a number of cases in which he has successfully foretold Russian weather during the past year, and he now extends his system. In the number before us (1st April, No. 2), we find charts for some seventy-eight places in Europe and North America, showing the probable course of the barometer and thermometer, etc., in the latter half of April; also maps with isobars and isotherms for one date in each week. Such claims, it is obvious, must be soon either justified or discredited, and we shall watch the result with interest. M. Demtchinsky evidently has faith in his system, and we wish him success with it. We regard with favour (personally) the rehabilitation of the moon which seems to be now in progress, but if this Russian engineer's claims can be established, then meteorology has of late made, in Russia, an unwonted leap forward. A complete and unbroken success in these forecasts need not, of course, be looked for, nor does the author expect it; but there might, perhaps, be a practically useful percentage of success. In any case, the question of lunar influence should be somewhat elucidated. Besides these forecasts, the journal will publish various meteorological papers, especially such as bear on the moon's influence. The journal is in four languages, Russian, French, English, and German. We rather doubt the utility of this; in perusing these polyglot serials, one is apt to be reminded of the "halfpenny-worth of bread to an intolerable deal of sack!"—A. B. M.

ZOOLOGICAL.—Much difference of opinion has prevailed among naturalists on the question of the pedigree of the leathery turtle (*Dermochelys coriacea*), some maintaining that it is a descendant from the same stock as ordinary turtles, while others assert that it is of totally different origin. In a paper recently contributed to the *Bulletin* of the Royal Scientific Society of Brussels, Mons. L. Dollo expresses himself in favour of the former view. According to this, the tesselated shell of the leathery turtle has been formed by a breaking up of the solid shield of ordinary turtles.

Perhaps a still more important contribution to phylogeny is afforded by Mr. R. I. Pocock's paper on the Scottish Silurian scorpion, which appears in the March number of the *Quarterly Journal of Microscopical Science*. As the result of an exhaustive study of a beautifully preserved specimen discovered in Lanarkshire in 1885, the author is inclined to countenance the idea that modern scorpions trace their ancestry to primitive Arthropods more or less closely related to the marine king-crabs (*Limulus*) of the Moluccas.

According to Mr. Southwell's Report on Whaling and Sealing during 1900, published in the March number of the *Zoologist*, British whalers are not to be represented in the Greenland seas during the coming season, owing to the scarcity of whales. What has become of the right whale in that ocean is the question of the hour. Whalebone of fair size now stands at the enormous price of £1400 per ton.

Those of our readers interested in the classification and pedigree of mammals should study an important memoir by Mr. B. A. Bensley, in the February issue of the *American Naturalist*. The relation of the marsupials to the placentals is the chief theme; and the author accepts the view that the specialised character of the foot in the former precludes their being the ancestors of the latter. He is, however, indisposed to admit the theory that marsupials are degraded placentals, and prefers to regard both as divergent offshoots from a common "metatherian" stock.

When Pallas in the latter part of the eighteenth century described the little creature we now term the lancelet as a kind of slug, under the name of *Limax lanceolatus*, he little realised the interest and importance attaching to his discovery. Little by little the true affinities of this lowly chordate have been worked out; and we now know that, instead of being represented only by a single species, the lancelets include quite a number of different types, which may be arranged under two generic and several subgeneric groups. According to Mr. A. Willey (*Quart. Journ. Micr. Science*, March, 1901), these may be classified as follows:—

Genus I.—BRANCHIOSTOMA; generative structures biserial.
Subgenus 1.—*Branchiostoma.*
„ 2.—*Dolichorhynchus.*
Genus II.—EPIGONICHTHYS; generative structures uniserial.
Subgenus 1.—*Epigonichthys.*
„ 2.—*Paramphioxus.*
„ 3.—*Asymmetron.*

In this table we have ventured to make certain amendments in nomenclature in accordance with modern ideas.

If any of our readers study marine worms they should read an important communication on the nemerteans of the Alaska seas, by Dr. W. R. Coe, published in the *Proceedings* of the Washington Academy of Sciences, as part of the results of the Harriman Expedition to Alaska. Quite a number of new forms are described.

The anatomy of a near relative of that remarkably generalised Arthropod known as *Peripatus* forms the subject of an important paper contributed by Dr. W. F. Purcell to the December issue of the *Annals of the South African Museum*. The form there described is referred to the genus *Opisthopatus*; and the author is of opinion that the African representatives of the group should be assigned to three generic types; two of which are exclusively South African, while the third also occurs in America, and possibly in India.

A late issue of the *Proceedings of the Royal Society*, contains an abstract of Dr. Blanford's memoir on the distribution of vertebrates in India, Ceylon, and Burma. The author comes to the conclusion that the Punjab differs so remarkably in its fauna from the rest of India that it cannot be included in the Oriental region, but must be assigned to the Mediterranean province, which is by some regarded as a region by itself, but by others classed as a subdivision of the Holarctic. To the latter belongs also the Himalayan area above the forests, as does Tibet. India proper, together with Ceylon, is regarded as a single subdivision of the Oriental region, under the title of Cisgangetic, while the Himalayas and Burma form a second subregion, the Transgangetic, which also includes Southern China, Tonquin, Siam, and Cambodia. A third subregion, the Malayan, is indicated in the area treated of by Southern Tenasserim, which agrees but in its vertebrate fauna with the Malay Peninsula.

THE BRITISH AND GERMAN ANTARCTIC EXPEDITIONS.—With the launch of the "Discovery" at Dundee on March 21st, and that of the "Gauss" at Kiel on April 2nd, the siege of the Antarctic regions may be said to have already begun. Both vessels have been specially designed and constructed, and it is hoped that both will be completed and set sail in July or August for the Antarctic regions. Moreover the two expeditions will co-operate, in so far that the scientific work will be

carried out on similar methods, and that the Antarctic area will, within practicable limits, be divided up between them. The British Expedition will be commanded by Capt. R. F. Scott, and Professor J. W. Gregory of Melbourne University will be chief of the scientific staff. The other members of the scientific staff already appointed are Dr. Koettlitz, surgeon and geologist; Mr. E. A. Wilson, also a surgeon, who combines with a good scientific training considerable artistic power; and Mr. Hodgson, of the Plymouth Biological Station, who will devote himself mainly to the zoological work. Captain Scott will have under him Lieut. A. B. Armitage, R.N.R., who has had three years' experience in Franz Josef Land, Lieut. Royds, R.N., Mr. Reginald Skelton, R.N., and two others not yet appointed. The crew, it is hoped, will consist of blue-jackets. The German expedition will be under the charge of Professor von Drygalski, who will have four scientific assistants, a captain, a first officer, two mates, and a crew, making twenty-eight in all. The "Discovery," the sixth ship of her name, is somewhat larger than the "Gauss," having a displacement of 1750 tons as against the 1450 tons of the German ship, and a length of 172 feet as against 151 feet. The "Discovery" will be capable of steaming 8 knots, and the "Gauss" 7 knots, but both ships will use their sails whenever possible for the purpose of saving coal. The ships are extremely strongly built in order to withstand the ice pressure, oak and greenheart being the timbers mainly used. On both ships each officer is to have a separate cabin fitted with every possible appliance to secure comfort and sanitation, and equal care will be taken with the quarters of the crews. The "Discovery" will have cabins for special purposes; laboratories for the biologists on deck; and others for photographic and other purposes below; the mainyard is to be fitted with a block for dredging operations; a special magnetic observatory will be constructed on the upper deck, and no iron will be used within thirty feet of it; she will carry five boats, twenty sledges and twenty dogs, and will be well supplied with every sort of amusement and appliance to make life as pleasant as possible through the long Antarctic night. The "Gauss" is also to be provided with laboratories and other special arrangements for scientific work. As far as possible the use of iron has been avoided in her construction, in the interest of the magnetic observations, and its place is taken by copper whenever feasible, and where this could not be done the iron has been coated with zinc. She will carry a windmill, material for a dwelling house, and four observatories; a captive balloon, fifty dogs, and a naphtha and other boats. Both ships will be fitted with electric light, and will carry provisions for three years.

THE INSECTS OF THE SEA.—III.

By GEO. H. CARPENTER, B.SC.(LOND.), *Assistant in the Museum of Science and Art, Dublin.*

BEETLES.

BEETLES are so very numerous, dominant, and widespread in all parts of the world and in all sorts of localities that the presence of a fair number by the tidal margin might reasonably be expected. And although if individuals be counted up, marine beetles will probably be found fewer than marine spring-tails, it is likely that in the number of kinds that occur, beetles outnumber all other insects, except possibly the flies, by the sea-shore, as they seem to do in the world at large.

The general form of a beetle is known even to those who have never studied in detail the structure of insects. The most characteristic feature is the modification of the forewings into firm plates of leathery or horny texture, to serve as shields—"wing-cases" or elytra—for the membranous hindwings—alone used in flight—which can be folded beneath them. Beetles thus form an easily recognised order of insects—the "Sheath-wings" or Coleoptera. And the folding up and putting away of the wings beneath their horny sheaths, as practised habitually by beetles generally, is suggestive of the fact that many beetles have entirely lost the power of flight. As a group the beetles have largely forsaken an aerial for a terrestrial life. Their armour-like coats, and the frequently flattened form in very many of the families, correspond with a life on the ground beneath stones, and in such concealed lurking places. Consequently adaptation to tidal conditions is less difficult to beetles than to typically aerial insects, and hence the large number of marine representatives of the order. Among the spring-tails we found that several large genera have each several species adapted for life on the sea-shore. The same state of things occurs among the beetles, but here the adaptation has proceeded further, since we shall find not species only but genera entirely confined to the tidal margin. A high degree of specialization for marine life has, therefore, been reached by many beetles.

It is well known that beetles undergo a "complete" transformation, the young insect being hatched from the egg as a grub or larva—wingless, and more or less unlike its parent, and attaining the perfect state only after passing through a period of rest as a pupa, in which the form of the organs of the future beetle can be clearly made out. There are many interesting steps in the progress towards a truly marine life that can be studied among the beetles. In the great family of the Leaf-beetles Chrysomelidæ), there is a genus (Donacia) whose species, found on freshwater plants, spend most of their time entirely submerged. Their grubs live at the bottom of the water, feeding on the roots of aquatic plants, and they are provided with two spines on the eighth abdominal segment, by means of which they pierce the roots and breathe from the air-spaces enclosed therein.* An allied genus, Haemonia, has a species *H. Curtisii*, Lac., found in brackish water on that characteristic marine plant the grass-wrack (Zostera). A similar progress towards life in the sea can be traced in other groups of water-beetles. The Gyrinidæ or "Whirligig" beetles, whose quick mazy dance on the surface of ponds and streams is well known, have a species (*Gyrinus marinus*, Gyll.) which is usually found in brackish water, though it also occurs in inland, freshwater localities. Among the aquatic beetles of the family Hydrophilidæ—characterised by the unusual length of the palps or jaw-feet of their first maxillæ, and their remarkably short feelers, the genus Ochthebius has several species, which frequent brackish ponds and ditches near the coast, and others which haunt stagnant rock-pools that are, at least during the high spring-tides, washed out by the rising sea.

Many of these Hydrophilidæ are not truly aquatic in their habits, but live in marshy places and damp decaying matter. To this section belongs the genus Cercyon, which has two species (*C. littoralis*, Gyll., and *C. depressus*, Steph.) inhabiting the sea-coast, and often

* L. C. Miall. "The Natural History of Aquatic Insects." London, 1895 (pp. 93–96).

occurring below high-water mark. These have invaded the tidal area not from the freshwaters, but from the land. Most sea-shore beetles, indeed, are incursors from the land. Many beetles of various families abound in salt-marshes and on coast sand-dunes; certain kinds can be traced down to high-water mark, whilst the most characteristic beetles of the sea dwell between tide-marks and undergo immersion twice every day.

In temperate countries at least, the Rove-beetles (Staphylinidæ) form the most numerous family of the order, and on the sea-shore they maintain this predominance. The form of these beetles is generally known. They are usually narrow, elongate insects, with very short wing-cases, beneath which the membranous hind-wings are nevertheless completely folded up and hidden when at rest. The hind-body, not as in most beetles, covered by the wing-cases, but projecting far beyond them, has all its seven segments firm-skinned and freely movable, so that this part of the insect can be turned about at pleasure; a number of Rove-beetles carry it turned upwards, as a scorpion carries its tail. Most of the Rove-beetles prey upon insects smaller or weaker than themselves.

Many salt-marsh and sand-haunting Rove-beetles belong to the large genus Bledius, which, with some allies, differs from most genera of the family by the feet having only three (instead of five) segments. The Bledii dig burrows in the sand or mud, and the material they throw up forms little heaps or castings. Several species live on sandy sea-coasts. The habits of *B. fuscipes*, Rye, were observed with some care years ago by Mr. K. Taylor; these insects seem to live amicably in pairs. At the bottom of a vertical burrow about an inch and a half deep, one individual—presumably the female—was found, while her mate mounted guard in a short horizontal tunnel opening out from the burrow near the surface of the sand.

Nearly allied to the Bledii, and of somewhat similar habits, are the smaller, more hairy and less spiny beetles of the genus Trogophloeus. These are often found in marshy places by the banks of streams. A new marine species, *T. anglicanus*, which has lately been described by Dr. Sharp from specimens discovered near Plymouth, is of uncommon interest, since it seems to be almost identical with a beetle (*T. unicolor*, Fauvel) of similar habits that lives on the coast of New Zealand. M. Fauvel, indeed, does not consider that the slight structural differences warrant specific separation. In his record of the discovery, Dr. Sharp† discusses the problem of this strange similarity, and considers that the only alternative to the highly unlikely suggestion that the insect has been brought by ships from the other side of the world, is that closely similar species have been independently developed here and at the Antipodes, under similar conditions of life. The possibility of a multiple origin for the same kind of animal in different localities can hardly be denied, since it is certain that the same variety can be thus independently produced under similar conditions, and what is a variety but a species in process of being made?

Quite a number of Rove-beetles may be found running among the decaying seaweed that is cast up by the high tides. Several of the large and widely-spread genera of these insects have each two or three species living in this way. The genus Aleochara for example (characterised by the presence of an extra tiny segment on each palp or jaw-foot) has three seaweed-haunting species widely distributed around our coasts. These are characterised by their dull blackish bodies, having a thick whitish hairy clothing. Such a covering is very often found on marine insects; its use to them is evident, as it serves to retain a layer of air around them when they undergo immersion. Even when covered by water they are not really wetted.

Similarly the large allied genus of Homalota has a small group of marine species. In their general aspect, the pale hairy clothing, the relatively short feelers, and the parallel sides of the hind-body, these Homalotæ are remarkably like the Aleocharæ just mentioned. By some authorities, therefore, the two groups of beetles are believed to be closely allied. But the minute structural differences between them—the number of segments of the palps and of the fore-feet for example—seem to show that their likeness to each other is the result of a convergence under similar conditions of life.‡

Belonging to the same group of the Rove-beetles as the Homalotæ are some small insects belonging to the genus Myrmecopora (or Xenusa), altogether adapted to a sea-shore life, only being found close to the water's edge, and often occurring between tide-marks. Two kinds—*M. uvida*, Er., and *M. sulcata*, Kies., inhabit our shores. These little insects may be seen either running briskly among the seaweed and on the rocks and shingle, or flying quickly in the sunshine. Sometimes they may be observed to alight on the water of a rock-pool, then, their expanded wings serving as sails, they are easily blown along on the surface-film.

Both the Aleocharæ and the Homalotæ are small insects—only about 3 mm. ($\frac{1}{8}$ inch) in length. There are, however, some more imposing Rove-beetles found among seaweed, measuring from 5 to 12 mm. ($\frac{1}{5}$ to $\frac{1}{2}$ inch). These are the species of Cafius, all of which seem to inhabit the sea-shore, or at least the margins of tidal rivers; they are nearly related to the beetles of the large and dominant genus Philonthus. We have four species on the British coasts—*C. cicatricosus*, Er., *C.*

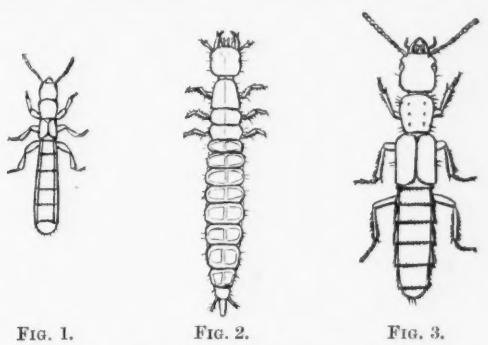


Fig. 1. Fig. 2. Fig. 3.

Fig. 1.—*Actocharis Readingii*, magnified 15 times.
Fig. 2.—Grub of *Cafius*, magnified 4 times.
Fig. 3.—*Cafius fucicola*, magnified 4 times.

fucicola, Curtis (Fig. 3), *C. xantholoma*, Grav., and *C. sericeus*, Holme. The first of these seems confined to the south coast; all the others are widespread, but only *C. xantholoma* can be considered common. *C. sericeus* is the only species of Cafius which has the woolly covering usually characteristic of marine insects. As one turns

† D. Sharp. "Some undescribed Species of *Trogophloeus*." *Ent. Mo. Mag.* XXXVI., 1900, pp. 230–4.

‡ W. W. Fowler. "The Coleoptera of the British Islands." London, 1887-91. L. Ganglbauer. "Die Käfer von Mitteleuropas." Wien, 1892, etc.

XUM

over the damp seawrack, one sees these beetles darting rapidly about; sometimes they burrow into holes in the sand. Deeper search among the heaps of seaweed may reveal their grubs (Fig. 2), which are narrow and pointed towards the tail end, the head as in the perfect insect is large and powerful, the legs strong and spiny, and the body rather strongly armoured. Both beetles and grubs appear to prey on the maggots which feed on the decaying vegetable matter found so abundantly in these seaweed heaps.

A little assemblage of Rove-beetles, to be looked for almost exclusively below high-water mark, are especially interesting. Actocharis is a genus of only one species—*A. Readingii*, Sharp—found on our coasts only in Cornwall and Devon, but occurring also on the French and Sicilian shores. This rare beetle is very small, only 1.5 mm. (about $\frac{1}{17}$ inch) long and of remarkably narrow form, even for this family (Fig. 1). This fragile little insect, covered with a dense silky pubescence, and with its unarmed legs very broad and flat, offers a strong contrast to the powerful and spiny Cafius. Some of its characters—such as the incomplete fusion of the pair of jaws (second maxillæ) forming the "lower lip"—mark it as a very ancient type.

The species of Phytosus are not quite so small as Actocharis. Their shape is characteristic, the hind-body widening towards the tail-end, and the feelers being relatively very short. Three kinds—*P. spinifer*, Curtis, *P. balticus*, Kraatz (Fig. 5), and *P. nigriventris*, Chev., inhabit our coasts; these little beetles fly in the sunshine. The first-named is often found running on rocks or shingle, while the two latter usually prefer to lurk under seaweed or refuse; a dead starfish often serves both as shelter and food for a large colony. These beetles occur all along the coasts of western Europe and north-western Africa; other kinds inhabit the shores of North America, and the genus reappears far away in the southern seas on the Falkland Islands and Kerguelen. Long considered as exclusively maritime, Phytosus (*P. balticus* (has lately been discovered almost in the centre of Ireland—that country of ancient survivals—on an islet in the freshwater reaches of the middle Shannon.

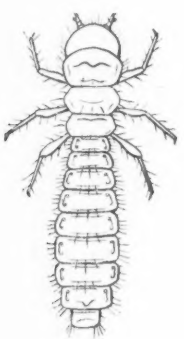


Fig. 4.

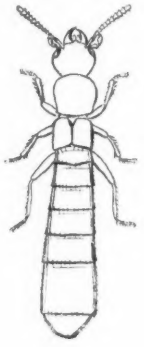


Fig. 5.

Fig. 4.—Grub of *Phytosus nigriventris*. (After Fauvel.) Magnified 24 times.

Fig. 5.—*Phytosus balticus*. Magnified 24 times.

The grub of *Phytosus nigriventris* has been described by Fauvel.§ It is remarkable in being very like its parent-beetle in shape, narrowed at the base of the hind-body and broadened towards the tail-end (Fig. 4). Such a likeness between perfect insect and grub is clearly a sign of antiquity, for the most highly-organised insects are the most unlike the larvæ whence they develop. The active, highly organized blowfly, for example, stands in the most extreme contrast to its sluggish degraded maggot.

(To be continued.)

§ A. Fauvel. "Notice sur quelques Aleocharien et description de Larves de Phytosus et Leptusa." *Ann. Soc. Ent. France* (4), II., 1862, pp. 82-94, pl. II.

Conducted by Harry F. Witherby, F.Z.S., M.B.O.U.

Notes on the Singing of a Song Thrush.—On the 24th of March, at 5.30 a.m., a thrush commenced its morning song in a garden at Stroud, where I was staying, and continued, with pauses of the usual brevity till 7 o'clock, when it was silent for rather more than two minutes by my watch; after which it sang till 8.15. It was not in the garden later in the day till 4 o'clock, when it began its evening song. This I did not time; but I feel sure that it exceeded two hours altogether. The musical range of pitch did not often exceed $3\frac{1}{2}$ tones, say, from C up to G. But sometimes an additional higher or lower note was given, so that the full range might have been an octave. Probably the bird sang elsewhere during the day, for in 1885 I timed a thrush (a very exceptional singer) for 16 hours in one day. The chief point of interest in such performances is not mere duration of song, but the great variety of the component sounds. In the present instance I counted thirty different strains or kinds of songs in the space of a quarter of an hour; and the first two dozen of these were given almost in succession. The last few, however, were heard at intervals in the reiteration of the commoner strains. From long familiarity with the subject, I made the record with some confidence. One cannot affirm that all these songs or strains were deliberately modulated; yet, when one remembers how much easier it would be for a thrush to repeat one strain time after time, as do the inferior songsters, it is apparent that this pleasing diversity must be intended. And different thrushes attempt it with unequal success. There is no positive proof that the thrush studies and deliberates in his singing, but the circumstantial evidence to that effect is strong, suggesting that the bird has a much higher plane of purpose and method than the mere prolongation of singing implies. It is remarkable that until the last few years the mimicry of the wild song thrush was never observed, or at least, never recorded. Yet some thrushes mimic almost as distinctly as starlings; and there are few pleasanter pastimes in warm weather than to rest under a tree in which a thrush is singing, and to

notice his varying success in efforts to reproduce some well-known cries of other common birds.—CHARLES A. WITCHELL, Cheltenham.

Nutcracker in Sussex (*Zoologist*, March, 1901, p. 107).—Mr. H. Marmaduke Langdale records that a Nutcracker was shot on December 21st, 1900, at Chilgrove, near Chichester. This bird was probably a straggler from the invasion of the eastern form of the Nutcracker into Scandinavia, Germany and Holland (*see* KNOWLEDGE, November, 1900, p. 256).

Hairy-plumaged Moorhens (*Zoologist*, March, 1901).—Mr. H. E. Forrest has, during the last three years, examined five specimens of a singular variety of the Moorhen taken at various places near Shrewsbury. These birds were light yellowish-brown on the upper parts, and very light grey underneath. The feathers, "instead of having the pinnæ united into a compact web, have them all separate, especially on the exposed portion of each feather." The defect extends to the flight feathers, so that the birds could not fly, yet they seemed healthy. By a microscopic examination, Mr. Forrest found that "the barbs and hooklets which, in ordinary feathers, cause the pinnæ to cling together in a compact web, are almost entirely absent on the body-feathers; whilst in the quill feathers many of the pinnæ have barbs on one side, but no hooklets to hold them together."

Black-tailed Godwit in Co. Wexford (*Irish Naturalist*, April, 1891, p. 93).—Mr. G. E. H. Barrett-Hamilton records that Black-tailed Godwits were very plentiful at Kilmore, in Co. Wexford, during December and January last. This bird is an irregular visitor to Ireland at any time, while in winter it has but rarely been observed.

Honey Buzzard in Solway (*Annals of Scott. Nat. Hist.*, April, 1901, p. 80).—In an article entitled "Zoological Notes from Solway," Mr. Robert Service describes how his friend, Mr. Jardine, found a Honey Buzzard on January 17th last. His collie dog "set" by a sheep trough, and a large "Hawk" got up and flew some forty yards. Mr. Jardine followed, and with no difficulty caught the bird. It was liberated in a barn, and there Mr. Service saw it, and pronounced it to be a "particularly fine Honey Buzzard in the most splendid condition." The bird had no signs of escape from captivity and no wounds, yet it was strangely tame, and allowed itself to be stroked. The appearance of a dog, however, caused its whole aspect to change "to a fierce and fighting attitude." The Honey Buzzard is a great rarity in Solway.

Barred Warbler in Barra (*Annals of Scott. Nat. Hist.*, April, 1901, p. 114).—On October 29th, 1900, Mr. W. L. MacGillivray shot a young Barred Warbler in Barra. This is but the third Scottish example, and curiously enough all have been obtained in the western isles.

Scops Owl in Shetland (*Annals of Scottish Nat. Hist.*, April, 1901, p. 116).—In KNOWLEDGE for August, 1900, p. 181, a bird of this species was noted to have been captured for the first time in Shetland. Mr. Clarke now records that a second specimen was obtained in the western part of the main island about the same time as the first.

All contributions to the column, either in the way of notes or photographs, should be forwarded to* HARRY F. WITHERBY, *at 1, Eliot Place, Blackheath, Kent.

Conducted by M. I. CROSS.

ILLUMINATION WITH ARTIFICIAL LIGHT.—The lamp that has proved most universally satisfactory is the regular one sold for microscopical work, with a ½-inch or ⅝-inch wick, but to many people this is objectionable for several reasons, the chief of which is that with the general use of gas and electric light, a mineral oil is not kept in the house, excepting for this special lamp; it also is not clean to handle, and requires a certain amount of attention; also it is not always immediately ready for service when required. In laboratories such a lamp is out of the question, and bare gas jets, or gas jets with upright chimneys, are generally to be found.

I have recently been making some experiments with gas and electric lamps to see if some practical form of illuminant, always available for use without special preparation, cannot be devised for critical microscopical work.

Two important considerations have to be kept in view, one is that the light must be brilliant, and the other is that it should be possible to focus an image of the source of light by means of the substage condenser, in the field of view.

A very serviceable illumination can be secured with the Welsbach incandescent gas light, but the reticulations of the mantle are an obvious objection, and the flame has too large a surface. These can be overcome by means of a shade of metal surrounding the chimney at a distance of three or four inches. In this shade a small rectangular or circular slot should be perforated. When working, this slot would be treated as the source of light and focussed accordingly.

At a recent meeting of the Royal Microscopical Society, Mr. Rousselet exhibited an incandescent electric lamp of the Edison and Swan "Focus" type, which has a somewhat coarse filament not unlike a corkscrew suspended horizontally in the bulb. This lamp gives an intensely brilliant light, and it has on many occasions been used for magic lantern purposes. It was recommended that the light for microscopical work should be taken from the edge of the filament and focussed in the same manner as the wick of an oil lamp. The light arranged in this way was, however, to my mind too much diffused, notwithstanding that a shade was used. On making further inquiry I find that a stand for an electric lamp is made for laryngological and aural examinations, which has joints and movements for adjusting in any desired position. In the usual type it carries an ordinary eight or sixteen candle-power lamp, but it will quite well carry the "Focus" pattern. If now an enclosing shade be provided similar to that described for the Welsbach light above, with an aperture which can be treated as the source of illumination, an ideal electric light for microscopy is secured. This would answer well also for photo-micrography.

A lamp, somewhat similar to the foregoing, has been used by me with considerable satisfaction, though long usage has created a distinct prejudice in favour of the ½-inch wick oil lamp.

All workers have not electric current available so this will not appeal to them, but the majority have gas, and where oil lamps are objected to, I would advise a trial of the Welsbach light arranged as described above.

PHOTO-MICROGRAPHY WITH ARC LAMP.—Trouble is invariably experienced in maintaining the light in one central position, and several devices have been resorted to in order to control this. No automatic lamp is really useful for the purpose, a hand-fed lamp must be employed. When this is properly adjusted and the condensing lens is in position, a luminous disc will be seen upon the leaves of the partially closed Iris diaphragm of the substage condenser. During an exposure it will only be necessary to maintain this disc in a fixed position by turning the milled head of the lamp very gently as required, and the light may be kept perfectly central for any length of time. It is presumed that a horizontal camera would be used.

STAINING FLAGELLA.—The preparation of Bacteria so as to exhibit flagella has always seemed to be unsatisfactory and difficult. Very few workers are really successful and none have produced permanent mounts. An interesting note occurs in the Thompson Yates Laboratories Report, by Dr. MacConkey, which deserves consideration.

It has been considered essential when staining such preparations to use a mordant, presumably to fix the dye in the substance of the flagellum. It is suggested that the rendering visible of the flagella in consequence of the use of the mordant is not because of the effect which it has hitherto been credited with producing, so much as by causing the flagellum to swell and become thicker. The flagella are of exquisite tennity, so much so, that when stained, the dyes do not seem to render them visible to the same extent as when a so-called mordant is used. The suggestion put forward is confirmed by the statement that the flagella appear to be thicker than they are supposed to be actually, and the organisms themselves are larger after the use of a mordant than when stained in the ordinary way.

There are dyes which have the effect of staining the flagella deeply and producing a thickening, but it is observed that, as

these colours fade, the flagella become increasingly fine until at last they are no longer visible.

This is a subject in which, to the ordinary microscopist, few opportunities are afforded of making experiments, but a good service would be rendered if some really definite and permanent process, based on an understood system, could be formulated.

THE ROYAL MICROSCOPICAL SOCIETY.—This Society is well known by name to microscopists in all parts of the world, but comparatively few are aware of the advantages that are associated with the Fellowship of the Society. It has ever been the foremost to recognise and to encourage progress and improvements in matters microscopical, and in consequence of the efforts of the various members, that progress and those improvements have been in many instances directly attributable to the Society's work.

The advantages directly derived by a Fellow of this Society are:—

He is supplied with a journal bi-monthly, published at 6s. per number, which is the most exhaustive publication on microscopical technique that is issued.

The rooms of the Society, together with a very fine library, cabinets of beautiful objects, and microscopes for making examinations, are open and available for use throughout the year with a short interval only in the middle of August.

The meetings of the Society are held at 20, Hanover Square, on the third Wednesday in each month, upon which occasion exhibitions of specimens and new apparatus are made, papers are read, and opportunities afforded for conversing with experts on various subjects.

The inclusive subscription per annum is £2 2s., but those living permanently abroad are entitled to become Fellows and receive the journals for a subscription of 31s. 6d. per annum.

The Secretary would be glad to give further information concerning this Society, and a ticket for admission to any of the meetings, on application to him at the Society's Rooms, 20, Hanover Square, W.

NOTES AND QUERIES.

W. E., Crewe.—The question naturally arises whether the microscope you require is to be used exclusively for petrological work, or do you wish it to be available for ordinary observations. If the former, the "Dick" microscope, by Messrs. Swift & Sons, is exceedingly efficient and comprehensive; if the latter, Messrs. R. & J. Beck, and W. Watson & Sons, offer some well-designed models. Of Continental manufacturers, R. Feuss, of Steglitz, is the one man whose petrological instruments have distinct advantages. It would be advisable for you to get catalogues from these different people, and ascertain by that means what features appeared to be of special importance for your work, and if then I could give you any further advice or assistance I would gladly do so.

The Rev. G. C. J.—Your trouble arises from using cedar-wood oil for clearing; you will find the following procedure answer well: Dehydrate in absolute alcohol, clear in chloroform, and transfer to paraffin.

W. H. C.—No further discussion has taken place on the Abbe diffraction theory, so far as I am aware. Diatoms can be found almost everywhere; the smallest ditch or pool, provided the water is not stagnant, will yield material. The specimen of which you send a sketch is probably a form of Navicula, but it is impossible to tell without actually examining the specimen. You are eligible for membership of the Quekett Club, and either the secretary, or the optical house from which you obtained your microscope, would put you in the way of being nominated.

Mr. Cooper Webb, F.C.S., has sent me a photo-micrograph of the Cat Louse—*Trichodectes subrostratus*. He states that this was "discovered by Mr. Parkes on some English cats at Eastbourne in February last, and may be of interest to some of the entomological readers of KNOWLEDGE, for according to such eminent authorities as Denny, Andrew Murray, and, I think, Burmeister, this parasite had not hitherto been discovered in the country." If any microscopists are interested in the above, I shall be pleased to put them in communication with my correspondent.

J. C. Webb.—I am communicating your offer to the society referred to.

W. P. Hamilton.—I am very much obliged for the red rain dust, and will mount some and give the result in next month's number.

R. H. M.—"Could you kindly inform me whether there is any book published that treats fully on the microscopical anatomy of insects, as I am anxious to take up that particular branch of research?" Can any reader offer a suggestion?

D. M.—"I have for some time made a special study of Desmidiaceæ, especially Closterium, and should be glad to know of some book which treated of the life-history of Desmidiaceæ. In particular I am anxious to discover the cause for swarms of Closterium, which in spring time come up from the mud to the surface of the water, quantities of ten to twenty being connected by a thin mucous filament."

Communications and enquiries on Microscopical matters are cordially invited, and should be addressed to M. I. CROSS, KNOWLEDGE *Office, 326, High Holborn, W.C.*

NOTES ON COMETS AND METEORS.

By W. F. DENNING, F.R.A.S.

THE frequency with which periodical comets escape detection is perhaps not a little remarkable. Recently the comets of Finlay, Barnard (1884), E. Swift (1894 IV.), and Brorsen have been sought for in vain. It is true that the conditions vary greatly at different returns, and are not often really favourable to the detection of these bodies. And in regard to those comets which have only been observed at a single apparition the positions are seldom accurately known. The visibility of these objects is also subject to considerable fluctuations, due to some inherent physical causes which are not well understood and cannot be sufficiently allowed for. Holmes's comet, which was, fortunately, detected at its first periodical return in 1899, was exceedingly faint then, though its conspicuous appearance in the autumn of 1892 justified the inference that it would be pretty bright. The failure in re-detecting some of these interesting bodies is to be regretted, since it is most desirable to obtain observations at multiple returns in order to determine the orbit elements with accuracy. Certain comets are only visible at alternate returns, others at one out of several returns. The numerous failures to pick up these objects cannot be ascribed to negligence on the part of those having the command of large instruments, for the latter have often been successfully employed in work of this kind. Perhaps the effort has not always been adequate to the occasion, and it is to be hoped that some more systematic method will be adopted in future. If combined action were arranged between the possessors of really powerful telescopes every expected comet might be effectively looked for, whereas under present circumstances some comets receive a good deal of attention, while others have very little, and are enabled to elude recovery.

The list of periodical comets is now very large, and increasingly so. But many of this class of bodies still remain undetected, and in proof of this Giacobini's discovery, in December last, of a comet belonging to the Jovian family may be cited.

DENNING'S COMET (1894 I.).—The return of this object is expected during the ensuing summer, but under circumstances which render it probable that it will escape detection. Herr P. V. Neugebauer gives the following sweeping ephemeris (Ast. Nach. 3700):—

Date.		I. P.P. May 9. α	I. P.P. May 9. δ	II. P.P. May 25. α	II. P.P. May 25. δ	III. P.P. June 10. α	III. P.P. June 10. δ
		°	°	°	°	°	°
April 7	...	60·6	+ 21·7	53·9	+ 19·4	48·4	+ 16·7
„ 23	...	75·8	+ 24·8	67·6	+ 22·7	60·6	+ 20·7
May 9	...	93·0	+ 26·2	83·4	+ 25·0	74·8	+ 23·5
„ 25	...	111·2	+ 25·6	100·6	+ 25·6	91·0	+ 25·0
June 10	...	129·0	+ 22·7	118·4	+ 24·1	108·3	+ 24·7
„ 26	...	145·3	+ 18·2	135·6	+ 20·6	125·7	+ 22·4

At the return of this comet in 1894, 293 observations were made, and it was last seen on June 5th in the 30-inch refractor at Nice, when its distance from the earth was about 138 millions of miles.

FIREBALL OF JANUARY 13, 1901.—At 10h. 35m. a meteor sufficiently bright to illuminate the sky was observed by the Rev. S. J. Johnson, of Bridport. Its course began mid-way between α and 45 Cancri, and ended after a duration of 7 seconds right across Castor. At first white, it finally dispersed in a stream of red sparks. The meteor was also seen at Beaminster, Dorset, where "its illumination resembled moonlight for about 10 seconds, when it appeared to split into fragments and disappear in a brilliant shower." It was also seen at Highbury, N., by Mr. Jewell, who describes it as of exceptional size and brilliancy. The meteor was directed from a radiant at 149°—12°, and fell from 61 to 52 miles

over the English Channel, disappearing 5 miles S.E. of Portland Bill. Path about 54 miles and velocity about 8 miles per second, according to Mr. Johnson's estimate of the duration. The fireball of 1866, Jan. 11, had a radiant at 158°— 8°, and probably belonged to the same stream of λ Hydrids as that of the recent meteor; but there seems to have been a wide difference in their velocities, for that of the former object was computed by Prof. Herschel as 46 miles per second.

FIREBALL OF JANUARY 28.—At about 9h. 22m. Mr. Robert Service, at Dumfries, noticed the flash of a fine meteor quite as bright as the half-moon, and perhaps a third less in apparent magnitude. In colour it shone precisely like an unshaded electric light, and took about 1¼ seconds to pass from about 330°+80° to 300°+51°. It went out suddenly with an explosion, showing red and blue sparks. Just three minutes later he heard "with great distinctness in the perfectly still air a sort of double detonation from the direction of low down in the N.N.W., followed by a short thundery rumble, but something in the sound was altogether unlike distant thunder." The meteor was observed by Mr. T. W. Backhouse at Sunderland, who noted the time as 9h. 18m., and describes the object as being one of the most magnificent he had ever seen. It disappeared from view at 342°+28½°, then passing behind a house. Its flight of about 15° was directed from the point 10½°+54°. The meteor exhibited a variety of colours, the chief being orange towards the last, and then for the last 3° or 4° sea-green, at last a very vivid green; while the bright sparkling tapering train of 4° or 5° was orange. It was also seen by several persons at Edinburgh. The radiant was at about 106°+52° in the Lynx, and the meteor descended from 76 to 16 miles above Lanark to Strathaven. Path about 61 miles, and velocity 18 miles per second. This brilliant object was directed from the Lyncid radiant, G.C. No. LXXXIV., 103.4°+50.8°, which seems to be visible during the greater part of the year.

THE FACE OF THE SKY FOR MAY.

By A. FOWLER, F.R.A.S.

THE SUN.—On the 1st the sun rises at 4.34, and sets at 7.20; on the 31st he rises at 3.52, and sets at 8.2. There will be a total eclipse on the 18th, but it will not be visible in this country even as a partial one; the belt of totality extends from Mauritius, through Sumatra, Borneo, Celebes, and New Guinea. Authorities now consider that the minimum of sunspots has probably been reached.

THE MOON.—The moon will be full on the 3rd at 6.19 P.M., will enter last quarter on the 11th at 2.38 P.M., will be new on the 18th at 5.38 A.M., and will enter first quarter on the 25th at 5.40 A.M. The following are the principal occultations during the month:—

Date.	Name.	Magnitude.	Disappearance.	Angle from North.	Angle from Vertex.	Reappearance.	Angle from North.	Angle from Vertex.	Moon's Age.
				°	°		°	°	d. h.
May 8	21 Sagittarii	4·9	12.39 A.M.	62	86	1.51	291	305	19 3
,, 9	*d* ,,	4·9	12.26 A.M.	122	153	1.23	222	247	20 3
,, 31	B.A.C. 5109	5·4	11.49 P.M.	44	34	12.36	336	319	13 19

There will be a penumbral eclipse of the moon, partly visible at Greenwich, on the evening of the 3rd. The first contact with the penumbra is at 4h. 6·3m., the middle of eclipse at 6h. 30·7m., and the last contact with the penumbra at 8h. 55·1m. At Greenwich the moon rises at 7h. 28m.

THE PLANETS.—Mercury is in superior conjunction with the sun on the 14th, and will afterwards be an evening star, but too near the sun for easy observation.

Venus is in superior conjunction with the sun on the 1st, and may therefore be considered not observable.

Mars remains in Leo, and will be in quadrature on the 20th. On the 1st he sets about 2.40 A.M., and on the 31st about 12.56 A.M. During the month his apparent diameter ranges from 9″·0 to 7″·2. On the 15th the illuminated part of the disc will be 0·895.

Jupiter is still in Sagittarius, rising on the 1st about 12.22 A.M., and on the 31st about 10.27 P.M. His path is a westerly one, a little to the south of ξ^2 Sagittarii. The apparent diameter on the 15th is 40″·4.

Saturn is also in Sagittarius, rising on the 1st about 12.35 A.M., and on the 31st about 10.34 P.M. On the 5th he will be 3° 18′ to the east of Jupiter. The apparent diameter of the planet on the 25th will be 16″·6, and the major and minor axes of the outer ring respectively 41″·5 and 17″·1; the ring is thus widely open, and the northern surface is presented to us.

Uranus is in the most southerly part of Ophiuchus, to the west of ζ and θ, making a nearly equilateral triangle with those two stars. He rises on the 1st about 10.30 P.M., and on the 31st about 8.27 P.M.

Neptune can now only be observed for a short time in the early evening, as he sets about 11.17 P.M. on the 1st, and about 9.22 P.M. on the 31st. He remains in Taurus, nearly midway between 132 Tauri and χ^1 Orionis.

THE STARS.—About 10 P.M., at the middle of the month, Ursa Major will be nearly overhead; Cygnus in the north-east; Vega pretty high up in the east; Arcturus a little east of south; Scorpio rising in the south-east; Spica Virginis in the south; Leo in the south-west; and Gemini a little north of west.

Chess Column.

By C. D. LOCOCK, B.A.

Communications for this column should be addressed to C. D. LOCOCK, Netherfield, Camberley, and be posted by the 10th of each month.

Solutions of April Problems.

(P. G. L. F.)

No. 1.

1. Q to R6, and mates next move.

No. 2.

Key-move.—1. B to K8.

If 1. . . B moves, 2. B to K3ch, etc.
1. . . Kt to B4, 2. Kt × KtPch, etc.
1. . . Kt × P, 2. Kt to K2ch, etc.
1. . . P to Kt4, 2. R to B5ch, etc.

CORRECT SOLUTIONS of both problems received from J. Baddeley, S. G. Luckcock, C. C. Massey, W. H. S. M., A. H. Machell Cox, Endirby, A. C. Challenger, W. de P. Crousaz, W. Nash, A. J. Head, G. A. Forde (Capt.), Alpha, G. W. Middleton, H. Le Jeune, F. J. Lea, F. A. Wilcock, J. T. Blakemore, G. Groom, H. Boyes, J. Sowden, W. Jay, J. M. K., G. W., Vivien H. Macmeikan, C. C. Pennington, A. E. Whitehouse, C. Johnston, Eugene Henry, J. E. Broadbent, J. A. Nicholson, E. Hunt, F. Dennis, C. Child, C. F. P.

Of No. 1 only from S. Jackson, A. Dod, H. W. Eleum, W. Clugston. The two former give 1. B to Q7 for No. 2; this appears to be met by 1. . . Kt to B4.

Mr. Eleum claims a solution in two moves by 1. B × Kt. Black, however, can pin the Knight by 1. . . B to Bsq.

S. W. Billings.—The Cheltenham post-mark on your card is unfortunately 10.45 a.m., April 11th. Your solutions, though correct, cannot therefore count in the competition.

Col. Bell.—Many thanks for the information, of which, as you will see below, I have availed myself.

W. Clugston.—Thanks for the problem. It is marked for insertion in the August number, the programme till that month being already complete. The solver you mention is well known; he competed, if I remember rightly, in a solution tourney in KNOWLEDGE some eight or nine years ago.

J. Baddeley.—I can only repeat that I know no other way of getting any decisive result from a competition limited to problems in two and three moves.

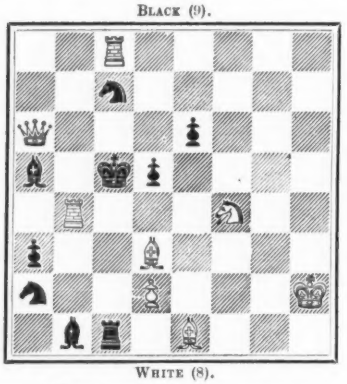
C. C. Massey.—Your deduction from the words "may possibly" is incorrect. The words show that problems of the nature alluded to were originally contemplated, but that, owing to their apparent unpopularity, they would, if given at all, be reserved for emergencies. You will see that, in your other reference, you have confused "problems known to have *no* solution" with "problems known to have more than one solution." The former class is certainly illegitimate, the statement "White mates in, etc," being clearly of the nature of a falsehood.

PROBLEMS.

By Mrs. W. J. Baird.

No. 1.

BLACK (9).

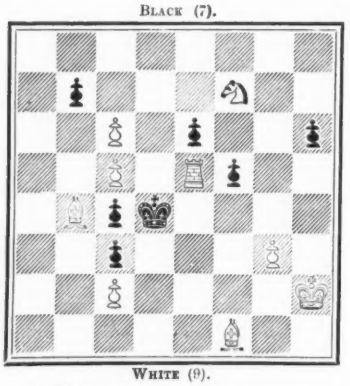


WHITE (8).

White mates in two moves.

No. 2.

BLACK (7).



WHITE (9).

White mates in three moves.

CHESS INTELLIGENCE.

The Anglo-American Cable Match will have taken place before this page appears. The British team will be weakened by the absence of Mr. Blackburne, who, so far as I know, has assigned no reason for his abstention. Fortunately it has been discovered that Mr. Mason is eligible, and he will probably be invited to take Mr. Blackburne's place. Mr. Burn is again not playing, and Mr. E. O. Jones will probably play instead of Mr. Trenchard, who has been out of form lately.

Herr C. Schlechter has again given evidence of consistent form by his victory in the Vienna Club Tournament with a score of 9 out of 11. Herr Alapin was second with 8, and Herren Albin and Marco divided the third and fourth prizes with scores of 6½ each.

Gloucestershire have defeated Wiltshire in the semi-final round of the Southern Counties' Competition by 10 games to 6. The final tie will presumably be against Surrey as usual.

The North *v.* South Correspondence Match is just concluding, any games unfinished on April 15 being sent to Mr. H. E. Atkins for adjudication. The full score will be given next month.

An important match between Lancashire and Yorkshire, played at Leeds on March 23rd, resulted in a win for Lancashire by 16½ games to 8½. Mr. Burn was playing for Lancashire; as is often the case he preferred not to take the first board. Last year Lancashire won by 20½ to 12½, but in 1899 Yorkshire obtained an easy victory by 20 to 11.

Mr. T. F. Lawrence has again risen to the occasion in the City of London Championship Tournament, having at present won 15 games, drawn 2, and lost 0. The other leading competitors are—Herbert Jacobs, won 14, drawn 3, lost 2; E. O. Jones, won 13, drawn 1, lost 3; W. Ward, won 13, drawn 3, lost 3; Dr. Smith, won 14, drawn 2, lost 5.

A correspondent points out that the chess-board puzzle, which appeared in the March number, had been printed in these pages some years ago. It appeared in the August and October numbers of 1886, where it is described as "the fine old 64—65 fraud." The writer of the article suggests a plan for making the discrepancy less obvious by dividing it between the square and the parallelogram, instead of, as usual, allowing it to fall on one of the two. In other words, instead of taking an amount of paper equal to 64 squares, and attempting to convince the victim of the fraud that it is also equal to 65, he takes an amount equal to 64½ squares and turns it at will into either an apparent chess-board or an apparent rectangle of 13 × 5. The rectangle is drawn first, and a thin parallelogram of an area equal to half a square is cut out from it and thrown away. For a full description of the ingenious method by means of which, as the writer claims, the discrepancy is rendered so unnoticeable that it cannot be detected, even by measurement, those interested in the matter should refer to KNOWLEDGE for October 1, 1886.

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